

COUNTY OF ROANOKE

ICLEI Milestone One

GREENHOUSE GAS EMISSIONS INVENTORY

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EXECUTIVE SUMMARY

Background. On August 14, 2007, the Roanoke County Board of Supervisors voted unanimously to join ICLEI - Local Governments for Sustainability. ICLEI is a worldwide organization dedicated to helping local governments generate political and public awareness of environmental and sustainability issues and providing technical assistance along with training and support to realize tangible goals. Its flagship program is Cities for Climate Protection (CCP), which provides software and technical assistance for measuring and reducing greenhouse gas (GHG) emissions. Roanoke County used ICLEI's Clean Air & Climate Protection (CACP) software to assist in preparing this report. Other Roanoke Valley municipalities are also involved in GHG assessments. The City of Roanoke has completed ICLEI Milestones One and Two, and the City of Salem is in the process of performing a GHG baseline emissions study.

ICLEI's CCP program consists of Five Milestones:

1. Conducting a GHG emissions inventory.
2. Adopting an emissions reduction target.
3. Developing a Local Action Plan.
4. Implementing policies and measures in the plan.
5. Monitoring and verifying results.

The benefits of undertaking this project are significant:

- Reducing the local community's contribution to global warming.
- Reducing long-term energy costs in an environment where coal and gas prices are either rising rapidly or are unstable.
- Improving local air quality, especially federally-regulated ozone and particulates (PM_{2.5}, also known as soot)
- Encouraging the creation of new, green jobs in the community.
- Building on Roanoke County's reputation as a clean, healthy place to live and work.

This report documents the fulfillment of ICLEI Milestone One for Roanoke County via performance of an inventory of GHG emissions. The measurements are expressed as carbon dioxide equivalent in either tons or pounds. This calculation is commonly referred to as the "carbon footprint" and to a great extent expresses local consumption of fossil fuels: coal, oil and natural gas.

The GHG Inventory Project. "You manage what you measure" is a useful business maxim and serves as the rationale for Milestone One. During the summer of 2008, Roanoke County staff organized a planning group to guide the County's ICLEI efforts. The first step consisted of measuring the carbon footprint for:

- The entire Roanoke County community, including residential, commercial, industrial and transportation sources; and
- County government (municipal) as a subset of the community carbon footprint.

The findings – Roanoke County community-wide.

The total carbon footprint for Roanoke County for the baseline year of 2007 was calculated to be over 1.86 million tons. This figure was arrived at by entering information from utilities, data from VDOT pertaining to vehicle types and total miles travelled, and other pertinent fuel and energy data into the CACP software.

After conversion to the CO₂ equivalent, the composition of Roanoke County's carbon footprint when viewed by energy source was found to be:

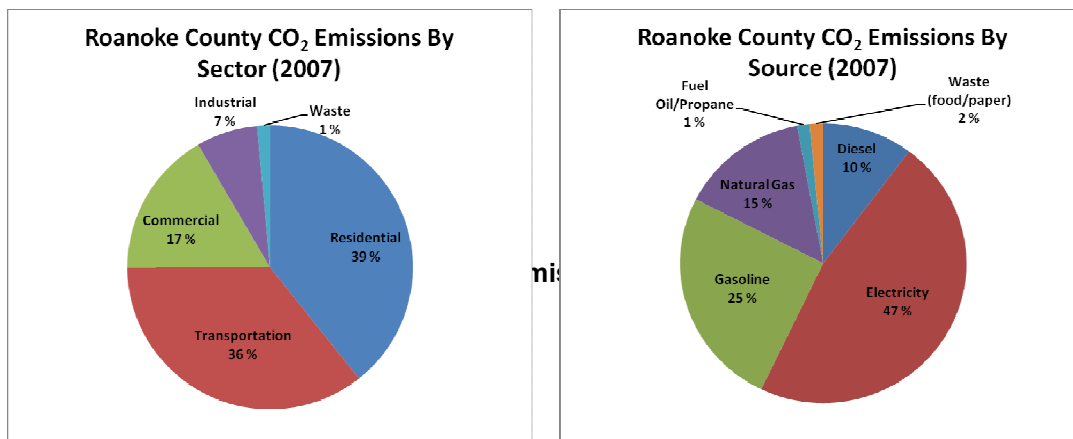
- 47% from using electricity.
- 25% from burning gasoline.
- 15% from burning natural gas.
- 10% from burning diesel fuel.
- 1% from burning fuel oil/propane.
- 2% from decomposing waste.

Electricity plays a disproportionately large role in the local carbon footprint because

- Over 88% of Roanoke County's electric power is derived from burning coal.
 - Coal emits about twice as much carbon dioxide per unit of energy as natural gas.
 - Coal emits about 50% more carbon dioxide than gasoline per unit of energy.
- (See Appendix A for details on coal compared with other fossil fuels.)*

When viewed by sector, residential usage is, not surprisingly, the biggest contributor, with transportation and commercial usages dominating the remainder.

- 39% residential
- 36% transportation
- 17% commercial
- 7% industrial
- 1% waste



Note that transportation includes all vehicles, commercial as well as private. The commercial and industrial sectors include energy used at the respective sites and other emissions generated by those users.

The findings – Roanoke County government. The County government’s carbon footprint was approximately 14,000 tons, less than one percent of the total for the community.

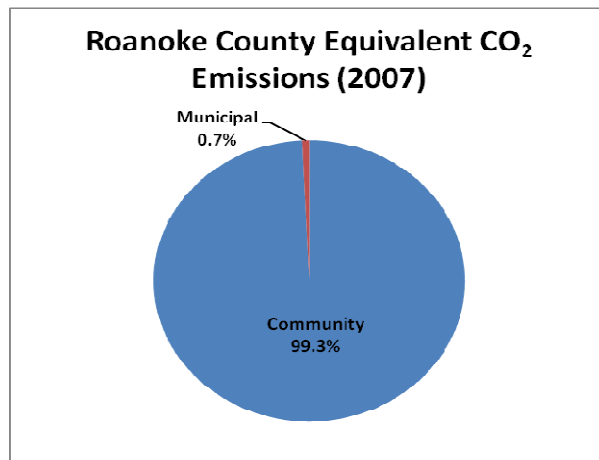


Figure 2: Comparison of Community and Municipal CO₂ Emissions (2007)

The majority of County government emissions comes from the fleet, followed closely by energy used to heat and cool buildings. However, the single greatest source of GHG is the County’s use of electricity, again because it comes from coal fired power plants.

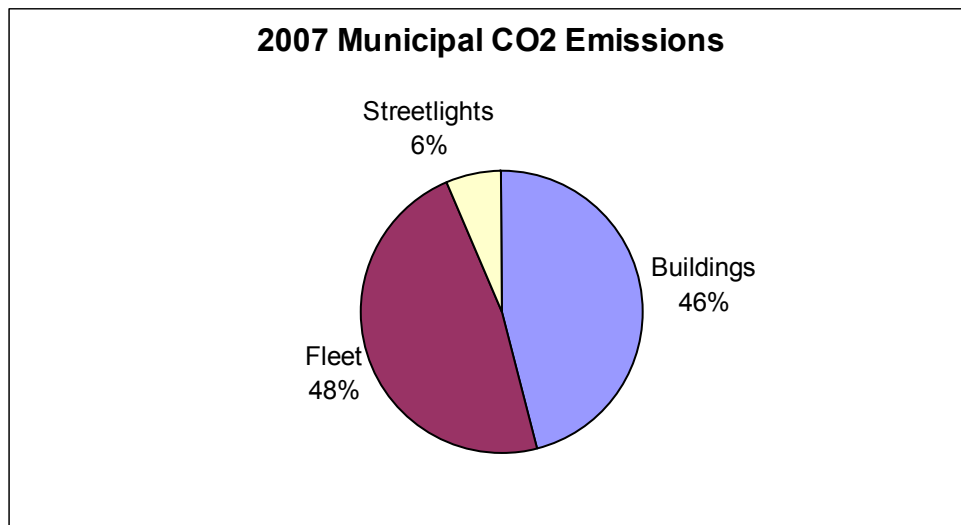


Figure 3: Percentage of Roanoke County Municipal CO₂ Emissions (2007)

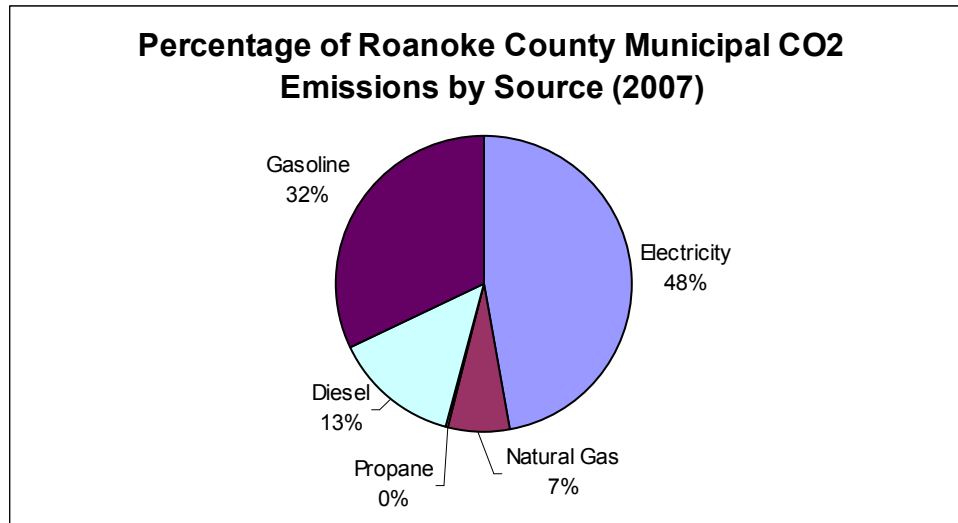


Figure 4: Percentage of Roanoke County Municipal CO₂ Emissions by Source (2007)

Administrative buildings, which include the Administration Center and the Courthouse, are responsible for the largest amount of emissions, followed by the Public Safety Center. Libraries and fire stations together are the next largest users, with Kessler Mill Road and Parks a distant third.

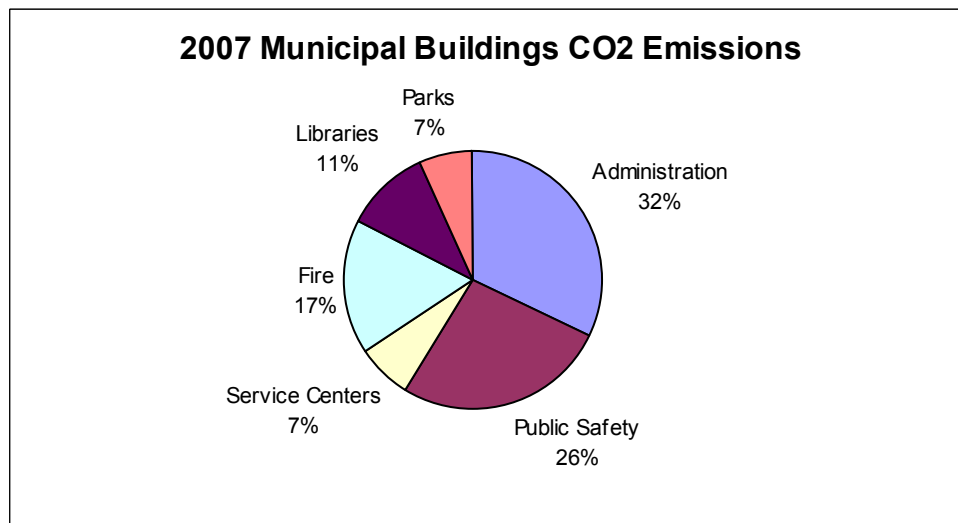


Figure 5: Roanoke County Percentage Municipal CO₂ Emissions by Sector (2007)

The County's fuel use has gone up between 2001 and 2007, which reflects additional vehicles on the road, particularly in public safety, but the cost has increased dramatically, as can be seen on the chart below.

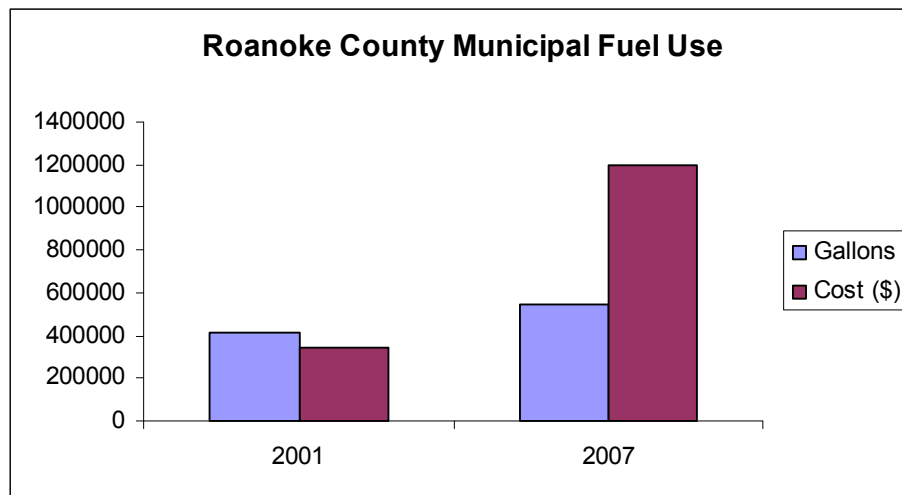


Figure 6: Roanoke County Municipal Fuel Use (2001 vs. 2007)

Management of the government's energy use is critical since:

- Energy use is a growing part of the County budget, a cost born by local taxpayers.
- Roanoke County has had an environmental management system since 2001 and has already demonstrated expertise in reducing energy use.
- County government can play a constructive role in educating and assisting local citizens and businesses with reducing their energy use.

Recommendations.

Using Milestone One data as a baseline, Roanoke County can now move into Milestones Two, Three and Four of the ICLEI process and then follow up with Milestone Five.

Milestone 2: Adopting emissions reduction targets.

- Most local governments aim to reduce GHG emissions by 2% of the baseline amount per year for the next forty years. This is the minimum level believed to be necessary to stabilize the amount of carbon dioxide in the atmosphere and thus to stabilize the global climate.
- The first steps in this process can be attained by adopting good conservation practices and implementing available energy efficiency technology. It is generally believed that such actions can bring about reductions of 20-30% over time.
- Later reductions are dependent on converting our energy systems to renewable sources.

Staff recommends adoption of a community target of 3% reduction of GHG emissions per year from 2010 to 2020. For the municipal sector, the target is to stop increasing GHG emissions by the year 2012, and then adopt a target of 3% reduction per year to 2020. In 2020, progress will be assessed and the reduction target revised, if needed, or continued at 3% per year until the goal is met.

Milestone 3: Developing a Local Action Plan

Developing the local action plan will be best achieved through formation of an action-oriented citizens' committee to be known as "Roanoke County Community Leaders Environmental Action Roundtable" (RC-CLEAR). RC-CLEAR'S primary purpose will be identifying ways to reduce emissions and long-term energy costs by developing strategies for improved energy efficiency and conservation. Appointments will be made by the Board of Supervisors, and the committee will be comprised of stakeholders who represent diverse elements of the community (e.g. commerce, industry, churches, and non-profits) and who are keenly interested in pursuing the goal of environmental sustainability.

Milestone 4: Implementing policies and measures

Recommendations from RC-CLEAR and other sources can be implemented in the Community and County operations as soon as they are developed and (if necessary) the budget allows. This approach is preferable to waiting until a comprehensive plan is worked out, because the County can benefit from early results while the planning process is ongoing.

Milestone 5: Monitoring and verifying results

It is anticipated that this process will be done by County staff and/or interns using the ICLEI software.

INTRODUCTION

The impact of our dependence on fossil fuels, primarily oil and coal, is playing a greater role in global, national, and local economies as an ever increasing sense of urgency has emerged in an attempt to deal with skyrocketing energy costs and climate events. In the United States, extreme drought in the West and Southeast have caused some of the worst wildfires in recent memory and have destabilized one of the largest metropolitan areas in the United States due to critical water shortages. Booming economies in Asia have placed increasing demands on fossil fuels which have resulted in dramatic increases in production of greenhouse gases. Thus, it seems as if there will be no end to this cycle despite efforts of many.

Greenhouse gases in our atmosphere trap heat, thereby insulating the Earth providing a life sustaining environment at an average 60°F. Water vapor and carbon dioxide (CO₂) are the most important and abundant of these gases; however, other greenhouse gases such as methane, nitrous oxide, and ozone also play a role. Burning fossil fuels releases CO₂ and other greenhouse gases, which have led atmospheric and climate scientists to conclude that human activities are responsible for much of the rapid increase in atmospheric greenhouse gases in the last 150 years. Additionally, there are indications that the temperature of the earth has risen more than 1°F over that same period with most of the increase occurring in the last three decades. The result of this increase may be seen in the decline of glaciers on a world-wide basis along with the dramatic shrinking of the polar icecaps.

The major contributor to global warming is society's use of fossil fuels. Many local governments, including several Virginia localities, are implementing activities that take a proactive approach to the use of fossil fuels. In Southwest Virginia, Roanoke, Blacksburg and Roanoke County have joined ICLEI - Local Governments for Sustainability, an international group of over 600 local governments that promotes local solutions to combat global climate change. Local organizations and private citizens have also formed the Roanoke Valley Cool Cities Coalition (RVCCC), a group of more than 120 affiliates representing over 15,000 citizens. Its primary mission is to educate and advocate for reduction of greenhouse gas generation in our valley through energy conservation and education.

The County of Roanoke has been addressing environmental concerns and the need for responsible stewardship of our natural resources for some time. The County instituted an Environmental Management System (EMS) shortly after receiving Environmental Protection Agency (EPA) training, along with other local governments, on the importance of having an EMS in place. In an effort to become better environmental stewards and avoid environmental problems, a policy was adopted by the Board of Supervisors in 2001 that:

- Identifies, evaluates, and manages potential environmental impacts of the County's activities and services;
- Brings environmental issues and solutions to the attention of County government;
- Complies with requirements of applicable environmental laws, regulations and other requirements to which the County subscribes;
- Employs pollution prevention to eliminate or reduce adverse environmental impacts; and

- Encourages other organizations to establish and implement Systems of Environmental Management.

In conjunction with this policy, an Environmental Assessment Team was established, consisting of department heads whose activities could potentially impact the environment, positively or negatively. A System of Environmental Management was fully implemented in the fall of 2002. Resultant efforts include discovery and remediation of a leaking underground waste oil storage tank at the County Garage, and conservation efforts that saved approximately \$77,000 in electricity and natural gas charges at our four major buildings from 2002 to 2005. Additionally, the County has received recognition from DEQ as an Environmental Enterprise (E2). This ongoing environmental programming also positioned Roanoke County to become a major player when the EPA designated the Roanoke Valley as a *Potential Non-Attainment Zone for Ozone* in 2004. A partnership with the Roanoke Valley-Alleghany Regional Commission (RVARC), City of Roanoke, Salem, Botetourt, Vinton, community agencies, and businesses led to the successful implementation of an Ozone Early Action Plan. This action avoided mandatory and potentially punitive measures by the EPA to reduce ozone concentrations.

Our efforts in the arena of conservation continue on an ongoing basis partly in an effort to save the County money and also to demonstrate sound environmental stewardship to our citizens. Conservation efforts are varied and include measures designed to reduce energy consumption. We have replaced hundreds of older T-12 lamps with the T-8 variety that use about 15% less energy. Conventional light switches have been replaced with motion sensors that turn lights off when rooms are not in use. Pumps and motors that fail are replaced with energy saving units. Appliances are replaced with Energy Star models. The Vehicle Resource Committee has overseen a gradual improvement of our fleet resulting in an overall average fuel economy increase in the last four years from 9.7 to 11.2 miles per gallon (mpg) with the resultant savings of thousands of gallons of fuel. We now own 11 hybrid vehicles that as a group average over 40 mpg. We have replaced dozens of large sedans that average 17 mpg with mid-size vehicles that get 5 - 6 more mpg.

In the spring of 2008, the County began utilizing 2% biodiesel fuel in its larger trucks and equipment and has recently increased this percentage to 5% (B5). This sustainable fuel is produced in Virginia and numerous other locations in the United States using either virgin soybean oil or, in some cases, waste fat from food production operations. When blended with conventional diesel at up to a 20% proportion, greenhouse gas emissions are reduced and performance is enhanced. At the same time we are reducing our dependence on foreign oil and also supporting American farmers.

The County has been certified as a "Green Government" by Virginia Municipal League through their "Go Green Virginia" initiative. The program encourages local governments to reduce carbon emissions generated by the locality and the community through the implementation of green policies and actions.

As we have seen in the very recent past, there is an ever present threat of extreme fuel shortages and price spikes, such as those experienced after recent hurricanes, justify prudent use of our fossil fuels and natural resources. Fuel and energy budgets have been stretched and now exceeded over the past couple years as prices continue to climb. Our services depend on utilizing vehicles and buildings so energy conservation must remain a constant fixture in County operations. The County is utilizing sustainable

technology in all future buildings. We are pursuing LEED™ certification (Leadership in Energy and Environmental Design) with an emphasis placed on energy efficiency for major capital projects, including the Regional Jail, South County Library, Fleet Service Center and Multi-Generational Center.

ICLEI BACKGROUND

Launched in the United States in 1995, ICLEI, or Local Governments for Sustainability (formerly the International Council for Local Environmental Initiatives) is an international association of local governments committed to improving the global environment through local action. Consisting of over 660 cities, counties, towns, and villages worldwide, ICLEI helps local governments generate political and public awareness of environmental and sustainability issues and provides technical assistance along with training and support to realize tangible goals. ICLEI accomplishes its mission primarily through two major programs. The flagship program, Cities for Climate Protection (CCP), is a performance-oriented campaign designed to empower local governments in reducing greenhouse gas emissions by offering a proven program model along with training and technical assistance.

The program consists of Five Milestones that include:

1. Conducting a greenhouse gas emissions inventory.
2. Adopting emissions reduction targets.
3. Developing a Local Action Plan.
4. Implementing policies and measures.
5. Monitoring and verifying results.

The second program, Communities 21, was developed in accordance with the United Nations Division for Sustainable Development Agenda 21. The mission is to improve the ecological health of communities around the world, while promoting economic vitality and social justice.

The decision to join ICLEI was made by the Roanoke County Board of Supervisors on August 14, 2007 via Resolution 081407-3 which was passed unanimously (Appendix B). Thereafter, the Board decided to participate in the CCP program due to the potential to reduce air pollution and greenhouse gas emissions, both of which will slow the progression of global warming. Since that time, a board and staff liaison to ICLEI was appointed and meetings were held to map a strategy to address the Five Milestones of the CCP. An ICLEI Planning Group (IPG) consisting of the board and staff liaisons, General Services Director, and the Chair of the Roanoke Valley Cool Counties/Cities Coalition was assembled to put together an implementation plan for the CCP.

Increased use of fossil fuels associated with industrial growth in the last 150 years has led to increasing quantities of carbon dioxide (CO₂) and methane being released into the atmosphere. These two gases are primary contributors to the Greenhouse Effect (GhE). In fact, current levels of CO₂, are 30% higher than in pre-industrial times. Scientists have been able to correlate the relationship of global temperatures to levels of atmospheric CO₂ and determine that temperatures rise and fall in response to those levels.

Additionally, levels of natural gas (methane, CH₄) are also rising due to human activities that include the decay of organic waste from sewage treatment, solid waste disposal, and raising large numbers of livestock for human food. While there is less methane than

CO₂ in the upper atmosphere, methane is estimated to be at least 20 times more effective in trapping heat than CO₂. Therefore, methane reduction should be considered in any effort to reduce the effects of climate change.

According to ICLEI documentation, NASA scientists have concluded that CO₂ levels are higher now than they have been in over 650,000 years, that the 1990's were the warmest years on record, and that this trend is continuing in the 21st century. Over the last 100 years the average global temp has gone up approximately 1.5°F. In addition, we have seen a disappearance of glaciers worldwide, shrinking of the polar ice caps and increasingly dramatic climate events.

In conjunction with the rising temperatures, we have seen a parallel increase in the numbers and ranges of destructive and disease bearing insects. Temperature dependent insects such as malaria-bearing mosquitoes have increased their ranges. More and more forests are being devastated by the gypsy moth. Brook trout populations and habitat are shrinking rapidly. The delicate balance of the complex and interrelated Earth ecosystem is in a state of flux; and it is impossible to predict how far reaching or devastating the consequences to life on earth will be.

Not surprisingly, combustion of fossil fuels used for energy also contribute to air pollution concentrated around metropolitan areas and include primarily ozone, smog and soot (fine particulate matter). This was illustrated at the recent Olympic Games held in Beijing, China, which is almost exclusively dependent on coal and petroleum for its energy supply. Numbers of asthma sufferers are steadily increasing and this, too, can be tied to rising ozone counts. It is becoming increasingly unhealthy to be active outdoors in the world's metropolitan areas.

Cities (& Counties) for Climate Protection

ICLEI's Cities for Climate Protection is designed to help cities and counties identify and quantify sources of GHG emissions as well as devise and implement plans to reduce them. The CCP initiative is tried and tested and has been in use for over ten years. As a member of ICLEI, municipalities receive free technical support, global member networking, benefit of their experience, and access to software tools and methodology designed to guide the process.

Battling air pollution is relatively new science and not the standard mission of local government. The Roanoke County Board of Supervisors chose to join ICLEI and gain the benefit of its experience and expertise in dealing with climate change. In exchange for committing to assess our carbon footprint and implement a plan to reduce it, we have received the use of tested, user-friendly software to perform the initial GHG inventory and, subsequently, to develop and implement a local climate action plan.

Furthermore, local benefits from reducing GHG are not the focus of the program, but nevertheless, result in sizeable financial and quality of life dividends. For example, the same fossil fuels that, when burned, create greenhouse gases, also result in air pollution in the form nitrous oxides (NO_x), hydrocarbons and volatile organic compounds (VOCs) and fine particulates (soot). Combined with heat and sunlight, these substances form ground level ozone, a pollutant that is regulated by the EPA under the Clean Air Act as it has been shown to be hazardous to human health.

Thus, it can be seen that when the use of fossil fuels is reduced there are global and local benefits. On a global scale, we are reducing the advance of climate warming and the associated environmental impacts. Locally, we are clearing our air, making it safer to breathe, conserving energy, saving money by conserving energy, reducing dependence on foreign oil and keeping dollars in the community, and providing a much needed stimulus for the local economy.

The ultimate goal of the CCP is to reduce GHG in the community, not only by government operations, but by engaging all sectors of society including residents, businesses, schools and religious institutions. This requires a variety of efforts including educational programs and outreach to all sectors along with a grass roots community approach to succeed. The County as a whole must work together to measure our carbon footprint, devise a plan to reduce it, and communicate that message while motivating our families, peers and coworkers. Especially important is the fact that there are no prescriptive measures or mandates -- the entire process is purely voluntary.

The Five Milestones: Overview

As the CCP methodology focuses on achieving greenhouse gas (GHG) reductions, the most logical place for local governments to start is by assessing their baseline emissions. When a local government completes the emissions analysis, the result is a profile of the community's energy, transportation and waste habits along with the corresponding GHG emissions. Based on these findings, the next step is to develop an emissions reduction target. While there is no hard and fast formula, this ideally will constitute a significant reduction (for example, at least 2% per year) over a broad enough time frame to have a measurable impact. The target reduction and emissions inventory set the stage for choosing GHG reduction measures that constitute a Climate Action Plan. An analysis of the kinds of emissions combined with community assets and motivation will guide the development of the Climate Action Plan. The next milestone is implementation of the plan which requires resources and personnel to assure the process moves forward. Lastly, monitoring and measuring CO₂ tonnage, along with reporting back to the community completes the process.

Milestone One

Conduct a Greenhouse Gas Emissions Analysis with Baseline Inventory and Forecast.

In the process of determining the quantity and subsequent impact of the GHG, it is necessary to understand the current and historic patterns of emissions for the community. While it is ideal to go back to 1990 levels in order to be in line with the US Mayors' Climate Protection Agreement, most communities find it virtually impossible to acquire data that old. Therefore, the standard many communities have used is to choose the oldest year for which complete, accessible data is available. While somewhat arbitrary, the choice of a baseline year is a critical part of the CCP because it is the yardstick against which all progress is measured.

The baseline GHG emissions inventory recommended by ICLEI consists of two separate analyses. One involves evaluating the residential, commercial, industrial, transportation, and waste records in the community. The other is focused primarily on local

government's building energy usage, fleet fuel use, and any other energy consuming operations.

Milestone Two

Establish a Reduction Target

This seemingly simple step of selecting a percentage reduction for GHG emissions and the resultant reduction in tons of CO₂ per year, over a given period, is possibly the most important step in the CCP initiative. It must be based on an accurate emissions inventory, an assessment of community resources, and the "conservation mindset". It should be a reasonably attainable number yet set high enough so as to have an impact on climate change processes. There is no hard and fast rule for this target, but some communities follow the US Mayors' goal of 7% below 1990 levels by 2012. Others follow the Cool Counties' guidelines of reducing GHG 80% below current levels by 2050 or about 2% per year.

Milestone Three

Develop a Climate Action Plan

This phase of the CCP initiative is critical in accomplishing the goal of reducing GHG emissions and limiting the effect of global warming. To succeed, it must be a collaborative effort of all sectors of the community including local government, citizens, commercial, industrial, educational, and religious organizations. All have a stake in the consequences of climate change and the ability to have considerable influence in reducing GHG emissions. The ICLEI Planning Group has recommended to the Board of Supervisors the creation of local climate action committee with representatives from each magisterial district and other stakeholders from the public and private sectors. Staff will develop a set of guidelines for the committee and submit them to the Board for review and approval.

The climate action committee has been named, "Community Leaders Environmental Action Roundtable", or CLEAR. Once selected, the committee will, with Roanoke County staff support, assess potential GHG reduction measures and recommend them to the Board of Supervisors. A separate set of measures will be developed for the community as a whole by CLEAR. The IPG will focus on County government operations GHG measures. It is anticipated that the CLEAR will be formed in early 2009 and have a climate action plan to recommend to the Board of Supervisors by the end of 2009.

Milestone Four

Implement the Climate Action Plan

The culmination of several years of data analysis and planning will be presented to the community as a plan that consists of a wide variety of **voluntary** measures. The implementation will be carried out over a number of years, perhaps even 40 years, but it will be based on an annual cycle. CLEAR and County staff will work with all interested parties in providing ongoing support of the implementation steps as well as keeping the Board of Supervisors apprised of progress. It is envisioned that there will be a need to market the plan via local media, including educational TV, radio and the printed media. Success will depend on getting the message out and a grass roots effort will be required

in order to reach “critical mass”. There is the perception that the success of this and neighboring communities’ climate action initiatives would be enhanced by a regional cooperative effort that could be coordinated by the Roanoke Valley-Alleghany Regional Commission.

Milestone Five

Monitor Progress and Report Results

Based on the GHG reduction target that is adopted, we will look for targeted reductions in emissions from year to year. With the help of local utilities and VDOT, annual energy use and motor vehicle miles travelled (VMT) data will be acquired yearly. This data will be translated into total tons of CO₂ emissions utilizing CACP or equivalent software. In this way, the effectiveness of various measures of the climate action plan will be assessed. Interventions may be tweaked to improve results or explore alternate measures. Given the fact that reducing GHG is a relatively gradual process that occurs over a considerable period of time, the climate action plan will need to become embedded in our lifestyles and how we do business. Community events celebrating successes will be necessary and frequent media updates. Various incentives and forms of recognition will go far toward engendering enthusiasm and support for the project.

METHODOLOGY

General

Subsequent to joining ICLEI, both a staff liaison and Board liaison were appointed as official County representatives to ICLEI. These individuals formed an ICLEI Planning Group (IPG) with the Director of General Services and the Director of Roanoke Valley Cool Counties Coalition. The task for this group was to develop a plan to launch the Cities for Climate Protection (CCP) project on behalf of the County of Roanoke. Thus the initial task of the IPG was to assess the Milestone Guidebook and develop a strategy for implementation.

Prior to embarking on a program to reduce GHG, the locality must first assess actual GHG emissions for a baseline year against which to measure progress throughout the duration of the project. In support of this critical effort, ICLEI provides its members with Clean Air & Climate Protection (CACP) software which provides virtually all the tools needed to tabulate and analyze GHG emissions. The critical activity and perhaps most challenging is the actual acquisition of the raw data. Given the fact that the bulk of GHG arise from the combustion of fossil fuels, the primary task is to acquire energy consumption records going back as far in the recent past as accuracy and accessibility allow. Secondly, consumption of vehicular fuels and/or total miles driven must be acquired. This takes care of the bulk of GHG sources. Lastly, acquisition of the total tonnage of solid waste completes the GHG inventory and will provide a reasonably accurate picture of the community and municipal carbon footprints.

Given the extensive time and effort involved in data acquisition and input in the CACP software, the IPG determined that at least during the initial implementation of Milestone One that the efforts of a full-time staff person would be required, possibly lasting for 3-4

months. For this an environmental internship was created and local colleges were solicited for applicants in the environmental science field. In addition to the environmental intern, it was also decided that the input and guidance of regional experts in the environmental sciences field would improve the accuracy as well as quality of the research for Milestone One. RVCCC really stepped up to the plate by writing a grant proposal to Roanoke Cement, a regional manufacturer concerned with environmental and air quality issues. A positive outcome was obtained and Roanoke Cement generously provided a grant to the Roanoke County ICLEI project. The grant was administered by RVCCC (Appendix C) and was used to employ Dr. Renee Godard, Hollins University and Dr. Sean McGinnis, Virginia Tech, through the collection and analysis of Milestone One information.

The IPG group was unanimous in its choice of a college senior from Roanoke College, majoring in Environmental Policy to serve as the Environmental Intern. This paid position was funded through the summer using existing environmental program funding. Several days of orientation were given, including a review of existing Roanoke County environmental projects and accomplishments, training on the Milestone Guide and CACP software. Subsequently, the intern contacted the Fleet and Facilities Divisions to begin acquisition of municipal operations data. An action outline and timetable were developed that included methodology, individual responsibilities, resources, data types and due dates.

The goal of acquiring all GHG raw data and entering it in the CACP software by summer's end was established. Initially, our intern was charged with working primarily on municipal data while the consultants focused on community-wide data. We were fortunate in that one of our consultants had already completed an emissions inventory utilizing ICLEI software. Separate sections follow detailing the results.

ROANOKE COUNTY EMISSIONS INVENTORY

Overview

The year 2007 was selected as a baseline year due to the quality of the data for both the community and government operations. In the process of collecting the data, some data was also collected for 2005 since it is often useful to look for historic patterns to understand current trends. While 2007 is the baseline year, the overall carbon emissions for previous years could be estimated as target reductions are contemplated in ICLEI Milestone Two. However, the baseline is the best basis for future comparisons.

A brief summary of the baseline results for 2007 is provided here before this data is detailed in later sections. Community- wide carbon dioxide emissions were approximately 1.9 million tons. The units for this result are accurately given as equivalent carbon dioxide emissions, as is common in such analyses, since other greenhouse gases have been accounted for by converting their contribution to an equivalent amount of carbon dioxide. The breakdown of these emissions is shown in Figure 7. Residential emissions are somewhat larger than commercial and industrial. Transportation emissions are nearly as large as the residential; however, this sector contains the transportation emissions for the residential, commercial, and industrial sectors as it is not easy to accurately separate this data. When the emissions are considered from a source perspective, electricity dominates. This is due to heavy

electrical use across the sectors other than transportation and the high carbon dioxide emissions from coal-fired electricity, the dominant source for local electricity.

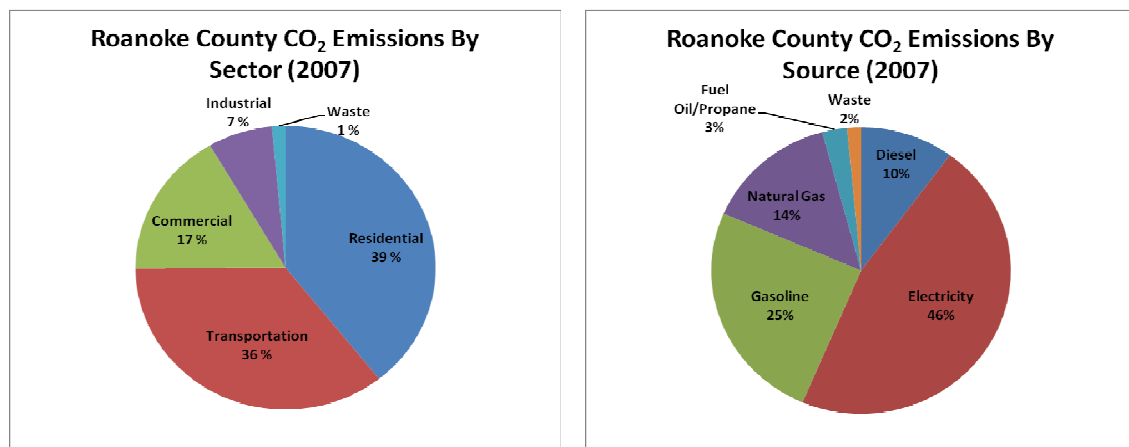


Figure 7: Roanoke County CO₂ Emissions by Sector and Source (2007)

Carbon dioxide emissions from Roanoke County government operations were approximately 14,000 tons. As shown in Figure 8, it is surprising that these emissions make up less than 1% of the total community emissions. This fact will be important in consideration of options for the local action plan to reduce community and governmental emissions.

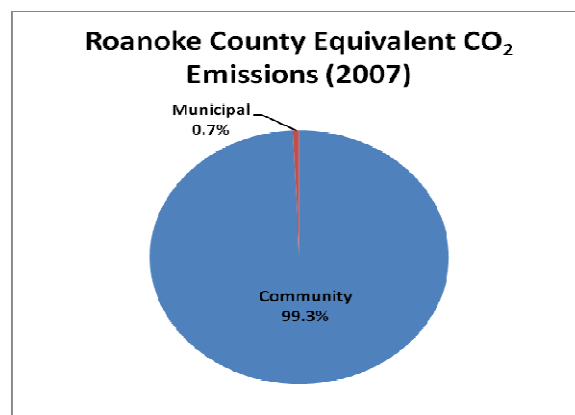


Figure 8: Comparison of Community and Municipal CO₂ Emissions (2007)

COMMUNITY EMISSIONS INVENTORY

As stated previously, this report assesses GHG emissions from two perspectives. The first perspective being the community as a whole, and the second perspective based on government activities only, or “municipal”. By definition then, “community emissions” encompass the entire County, inclusive of all sectors and sources insofar as data is

available. This includes the municipal energy usage and GHG generation as well. Based on the fact that the bulk of GHG are caused by the combustion of fossil fuels, this effort entails acquiring data primarily from the energy and transportation sector. Subsequently the energy data is converted to carbon equivalents utilizing CACP software.

Several contributors to greenhouse gas emissions were left out of the scope for this baseline. These include emissions from both air travel and railroads. Accurate data for these sectors is difficult to acquire. Moreover, there are no standards by which such emissions are divided among communities since both transportation methods cover large distances.

It should also be noted that this baseline inventory, like most others completed by communities, does not include upstream emissions associated with the consumption of food and products. These emissions are assumed to be accounted for in the communities in which the emissions related to energy use and transportation occur.

While the previous comments may seem troubling, it is important to realize that baseline inventories can never account for all emissions in a community. In spite of this, baseline inventories are still critical and useful for comparisons and developing action plans. The majority of emissions must be accounted for and the data has to be accurate and well documented to allow for the same data collection and analysis in the future.

Electricity

Electricity data was provided by the Appalachian Power Company (APCO), a division of American Electric Power (AEP). Details are provided in Table 1 and Figure 9. The boundaries for this data included Roanoke County and Vinton as defined by APCO using their "tax district" reporting field. Therefore, the electricity values correspond to billed usage and can be broken down into sectors since electrical rates vary depending on end use. The sectors are defined by the US Department of Labor's North American Industry Classification System (NAICS - <http://www.osha.gov/oshstats/naics-manual.html>).

Briefly, businesses classified as "Industrial" produce or manufacture something. Those classified as "Commercial" provide a service (they don't employ capital to produce something from raw materials or perform some intermediate step in the manufacturing process). A hospital is considered "Commercial", unless it is owned and operated by a government entity (i.e., a Veterans Administration Hospital, etc.). In this case, it would fall into the "Other" category which includes local, state, federal governments, and Public Authorities (i.e., Water Authority, Airport Authority, etc.).

Roanoke County + Vinton Electricity (kWh)				2007 vs. 2005	
Sector	2005	2006	2007	2007 (%)	% Change
Residential	560,818,716	551,997,691	579,674,616	50.7%	3.4%
Commercial	327,787,840	324,607,143	336,326,919	29.4%	2.6%
Industrial	166,444,852	167,399,946	172,211,165	15.1%	3.5%
All Other	54,451,396	54,086,641	55,002,492	4.8%	1.0%
Totals	1,109,502,804	1,098,091,421	1,143,215,192	100.0%	3.0%

Table 1: Roanoke County electrical usage (2005 – 2007)

The effect of annual temperature variation on energy use can be analyzed using the concept of a **degree day**. The baseline for this degree day is specified at 65°F. Days on which the average temperature is above this temperature will register as **Cooling Degree Days (CDD)** while days on which the average temperature is below this temperature will register as **Heating Degree Days (HDD)**. To determine CDD, 65°F is subtracted from the average daily temperature. For HDD, the average daily temperature is subtracted from 65°F. The annual amount of energy used for heating and cooling is roughly proportional to the total number of heating and cooling degree days in a year.

Table 2 shows degree day data (known as F-6) for the Roanoke region from the National Weather Service Data (<http://www.erh.noaa.gov/rnk/climate/f6/html/F6.html#ROA>).

Month	2005		2006		2007	
	HDD (65)	CDD(65)	HDD (65)	CDD(65)	HDD (65)	CDD(65)
January	751	0	658	0	731	0
February	647	0	704	0	854	0
March	640	0	506	5	393	32
April	251	11	153	35	297	34
May	113	37	123	79	76	163
June	9	247	3	225	4	292
July	0	403	0	398	0	341
August	0	399	0	420	0	537
September	11	201	65	77	21	225
October	186	44	305	16	137	101
November	447	0	435	1	494	0
December	864	0	612	0	659	0
	3,919	1,342	3,564	1,256	3,666	1,725
		5,261		4,820		5,391

Table 2: Heating and Cooling Degree Days for Roanoke County (2005-2007)

From Table 1, it can be seen that there was a 3% increase in electrical consumption from 2005 to 2007. However, over the same period, there was a 28% increase in cooling degree days. The increase in electrical consumption may be attributed to an increase in the demand for energy for cooling which typically requires electricity. It is interesting to note, however, that the increase in electrical usage is far less than the increase in cooling load.

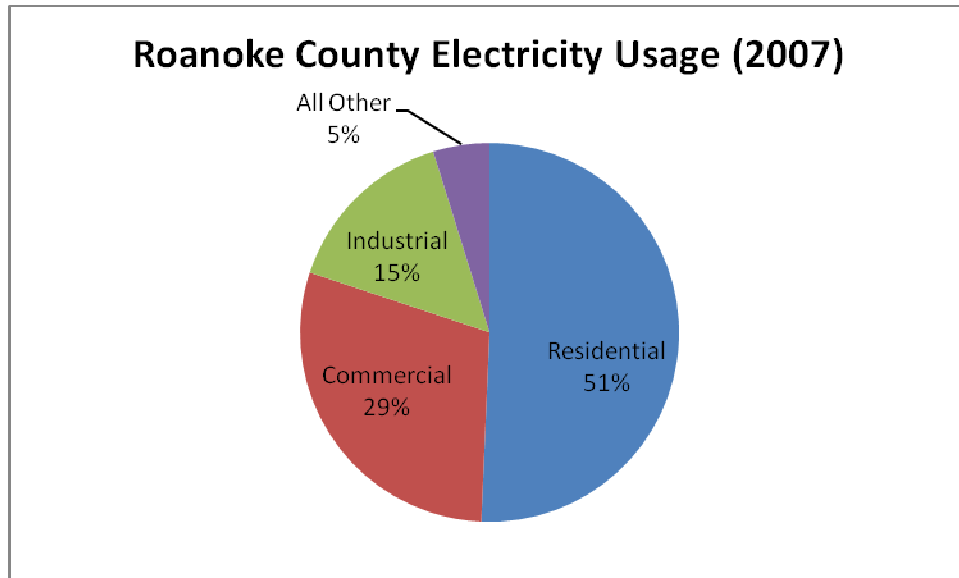


Figure 9: Roanoke County electrical usage by sector (2007)

GHG emissions due to electricity use come from the power plants which may not be located in the community. As such, these emissions do not generally occur directly within the community, and this is the case for Roanoke County. Greenhouse gas emissions are more of a global concern, while criteria air pollutants have more local and regional effects. Criteria air pollutants include nitrous oxides, hydrocarbons, particulates, and volatile organic compounds (VOCs) and are the major constituents of ozone and smog. While a serious problem in Roanoke, these will not be discussed in this report but can be assessed using the CACP software.

Accurate emission estimates due to electricity require the proper emission coefficients which detail the individual emission amounts based on a per kWh basis. Default coefficients are contained in the CACP software in the *Average Grid Electricity Set* database and vary significantly depending on the specific fuel mix used to generate the electricity. For example, electricity generated by coal has more carbon dioxide emissions per unit energy than that generated from natural gas which in turn emits significantly more carbon dioxide than hydropower or nuclear generated electricity. Please note that these emission coefficients typically only consider the emissions released in the generation and transmission phases of the electrical generation life cycle and do not include any emissions related to extraction of, processing, and transportation of fuels on capital equipment and waste disposal.

Based on APCO published regulatory data (see Appendix D), the *Average Grid Electricity Set* in the CACP software was modified to better reflect the fuel mix for the electricity used by Roanoke County. Table 3 shows the adjustments that were made to Region 09 - South East Reliability Council/Excl. Florida values due to the higher percentage of coal use for power generation by APCO for Roanoke as compared to the regional averages as shown in Table 4.

Emission Chemical(s)	2007 CACP Default Coefficients (lbs/kWh)	2006 APCO Data (lbs/kWh)
CO ₂	1.4	1.85
NO _x	0.002	0.0031
SO _x	0.008	0.0108

Table 3: Electrical power generation emission coefficients

Fuel	SERC (%)	APCO (%)
Coal	38.0	88.3
Nuclear	16.0	10.9
Hydro	6.0	0.8
Net Internal Purchases	9.0	0.0
Pumped Storage	3.0	0.0
Dual Fuel (Gas/Oil)	12.0	0.0
Gas	14.0	0.0
Oil	2.0	0.0
TOTAL	100.0	100.0

Table 4: Electrical power generation fuel mix comparison

Natural Gas

Natural gas data was provided by the Roanoke Gas Company which is the primary supplier of natural gas in the area. The boundaries for this data included the Roanoke County and the Town of Vinton using tax districts for the calendar years 2005 and 2007. The natural gas data in units of therms (100,000 BTU) was divided into subcategories in Table 5 and graphed in Figure 10. Residential natural gas use is seen to be higher than use in the commercial and industrial sectors. Natural gas is used in the community primarily for heat (boilers and furnaces), on-site electricity generation (generators), and cooking (ranges, grills) so the emissions have a stronger local impact compared to those for the power plant electricity.

It can be seen that residential consumption went down 8.6% from '05 to '07 and this is most likely attributable to fewer heating degree days, falling from 3919 in 2005 to 3666 in 2007. Increase in the commercial sector is most likely due to retail and commercial growth, while the decrease in industrial natural gas consumption can only partially be explained by a 7% decrease in heating degree days.

Roanoke County Natural Gas (Therms)

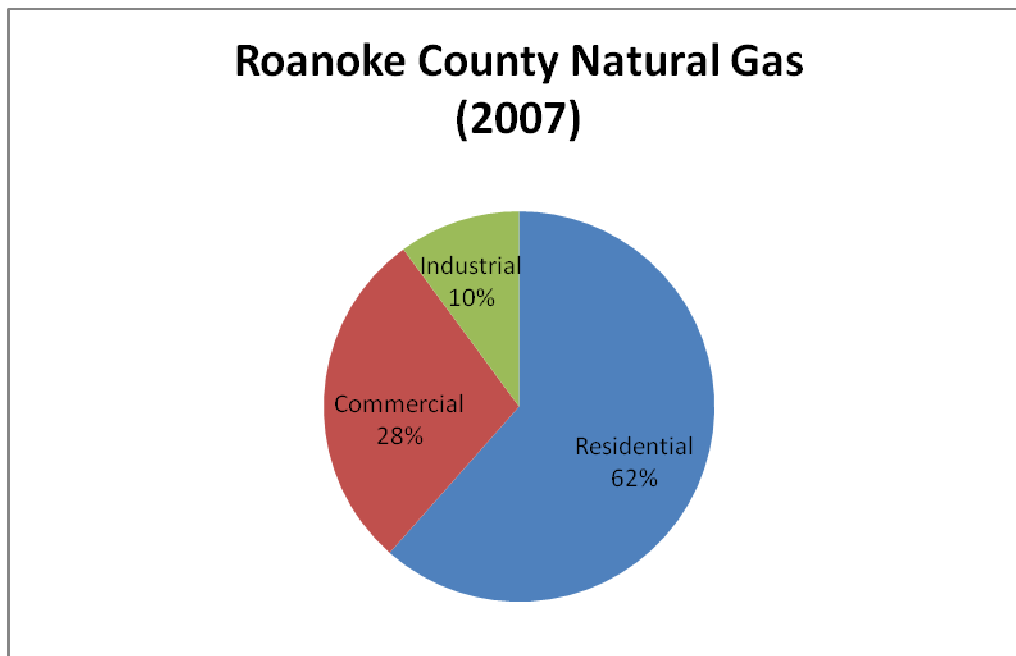
Class	2005	2007	2005%	2007 vs. 2005
Residential	26,843,721	24,638,331	63.4%	-8.2%
Commercial	10,482,567	11,022,731	24.8%	5.2%
Industrial	5,024,410	3,205,568	11.9%	-36.2%
Totals	42,350,698	38,866,630	100.0%	-8.2%

Vinton Natural Gas (Therms)

Class	2005	2007	2005%	% Change
Residential	2,592,321	2,277,700	45.9%	-12.1%
Commercial	1,588,320	1,393,536	28.1%	-12.3%
Industrial	1,469,000	1,210,824	26.0%	-17.6%
Totals	5,649,641	4,882,060	100.0%	-13.6%

Combined Natural Gas (Therms)

Class	2005	2007	2005%	% Change
Residential	29,436,042	26,916,031	61.3%	-8.6%
Commercial	12,070,887	12,416,267	25.1%	2.9%
Industrial	6,493,410	4,416,392	13.5%	-32.0%
Totals	48,000,339	43,748,690	100.0%	-8.9%

Table 5: Roanoke County natural gas usage (2005 & 2007)**Figure 10: Roanoke County natural gas usage by sector (2007)****Propane and Fuel Oil**

Residential fuel oil and propane (LPG) household estimates specific to Roanoke County were obtained from the 2007 American Community Survey data on the US Census Bureau website (<http://factfinder.census.gov>). Average annual consumption of these fuels per household was obtained from the Department of Energy's 2005 Residential Energy Consumption Survey based on the South Atlantic regional data.

(http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/c&e/pdf/tableus8.pdf)

Table 6 shows both sets of data and the total estimates for the annual use of these fuels.

Note that these values are for Roanoke County only, not including Vinton since the latter data was not available. Changes from year-to-year using such data will not be highly accurate, but the totals are useful relative to other energy sources and carbon emissions for the community.

Residential Fuel Source	Number of Households	Annual Consumption (gallon/year)	Total Consumption (gallon/year)	Energy (Million BTU)
Fuel Oil	3639	576	2,096,064	293,359
Propane (LPG)	912	343	312,816	29,187

Table 6: Community fuel oil and propane use for residential heating (2007)

Transportation Energy Usage (Fuel)

Transportation fuel estimates are considerably more difficult and less accurate than those for electricity and natural gas. Fuel is purchased by a large number of community customers from a variety of sources. Emissions from transportation fuel combustion depend upon the amount of fuel used, the type of fuel, and the characteristics of the engine which is combusting the fuel. As such, various methods can be used to estimate fuel usage, each with advantages and disadvantages. Since actual fuel purchases cannot be obtained on a community basis, estimates are generally made either based on Vehicle Miles Travelled (VMT) or Average Annual Daily Traffic (AADT) data. The former method was used for this analysis based on data from the Virginia Department of Transportation (VDOT) for Roanoke County and the Town of Vinton.

Daily Vehicle Miles Travelled (DVMT) as a function of physical jurisdiction and vehicle class for secondary, primary, and interstate roads were compiled from Report Number 1220 at the following VDOT site for 2005 and 2007:

<http://www.virginiadot.org/info/ct-TrafficCounts-VMT2005.asp>
<http://www.virginiadot.org/info/ct-TrafficCounts-VMT2007.asp>

The detailed DVMT compiled data for 2007 is shown in Table 7.

	Federal Vehicle Class	DVMT	Annual VMT
1	Motorcycles	8,014	2,925,285
2	Passenger Cars	1,821,573	664,874,276
3	Two Axle, 4 Tire Single Unit Vehicles	336,943	122,984,276
4	Busses	12,090	4,412,755
5	Two Axle, 6 Tire Single Unit Trucks	17,411	6,354,982
6	Three Axle Single Unit Trucks	12,747	4,652,664
7	Four or More Axle Single Unit Trucks	2,615	954,521
8	Four Axle or Fewer Single Trailers	9,649	3,521,959
9	Five Axle Single Trailers	194,335	70,932,407
10	Six or More Axle Single Trailers	1,734	633,034
11	Five Axle or Fewer Multi-Trailers	11,150	4,069,864
12	Six Axle Multi-Trailers	3,907	1,425,956
13	Seven or More Axle Multi-Trailers	19	6,821
Roanoke County + Vinton Total		2,432,188	887,748,800

Table 7: Roanoke County DVMT (2007)

Fuel usage is the information needed to estimate carbon dioxide emissions and this is obtained by dividing VMT by fuel economy (miles per gallons). Since fuel economies vary among vehicle types and fuels, the VMT data in the table above was divided up among the vehicle types in the CACP software. The CACP vehicle categories are shown along with the default distribution in the Tables 8 and 9.

	Gasoline	Diesel	Gasoline	Diesel
CACP Vehicle Category	Distribution (%)	Distribution (%)	Annual VMT	Annual VMT
Full Size Auto	8.5	0.3	59,993,963	2,117,434
Mid Size Auto	18.7	0.0	131,986,719	
Compact Auto	33.0	1.3	232,917,740	9,175,547
Light Truck/SUV/Pickup	32.4	0.0	351,667,148	
Heavy Truck	0.0	5.2		92,552,208
Motorcycle	0.4	0.0	2,925,285	
Passenger Vehicle	0.0	0.0		
Vanpool Van	0.0	0.0		
Marine	0.0	0.0		
Rail Commuter	0.0	0.0		
Transit Bus	0.0	0.2		4,412,755
Totals	93.0	7.0	779,490,855	108,257,944

Table 8: Roanoke County VMT by vehicle class (2007)

Passenger Auto Distribution:	Gasoline	Diesel
Full Size Auto (% of passenger cars)	9.0%	0.3%
Mid Size Auto (% of passenger cars)	19.9%	
Compact Size Auto (% of passenger cars)	35.0%	1.4%
Light Truck/SUV/Pickup Truck	34.4%	
Totals	98.3%	1.7%
		100.0%

Table 9: Passenger auto distribution based on CACP defaults

The VMT method assigns emissions to the community for all vehicles on community roadways, independent of whether the vehicle is registered in the community. The VDOT website has additional information which is useful when considering measures to reduce VMT. Specifically, DVMT by Physical Jurisdiction for All Roads is provided in Report Number 1200 and was considered for 2005 and 2007 in Table 10.

<http://www.virginiadot.org/info/ct-TrafficCounts-VMT2005.asp>

<http://www.virginiadot.org/info/ct-TrafficCounts-VMT2007.asp>

Please note that the total VMT for 2005 and 2007 were almost identical. In addition, interstate roads accounted for a disproportionately larger number of miles travelled at nearly 41% even though interstate roads represent only 2.4% of the total roadway length in Roanoke County and Vinton.

Road Category	DVMT	Annual VMT	% of Total Road Miles	% of Total DVMT
Secondary	500,044	182,516,095	84.4%	20.6%
Primary	949,978	346,742,144	13.2%	39.1%
Interstate	982,166	358,490,561	2.4%	40.4%
Totals	2,432,188	887,748,800	100.0%	100.0%

Table 10: Roanoke County VMT by Road Category

Waste Disposal

Waste contributions to emissions are estimated by the CACP software for a variety of disposal scenarios. Landfills emit methane, a greenhouse gas at least 20 times more potent than carbon dioxide as a result of the anaerobic decomposition of organic matter and constitutes one of the largest methane sources in the United States.¹ Only greenhouse gas emissions are estimated by the software since there is a lack of accurate information regarding the criteria air pollutants emitted from wastes.² In the CACP analysis, managed landfills are also given some credit for CO₂ sequestration which reduces the equivalent CO₂ emissions from the landfill. One argument for this assumption is that the carbon stored in a managed landfill will not be emitted like incinerated waste where carbon dioxide is emitted due to the combustion process.

Roanoke County waste is sent daily by railroad to the Smith Gap Landfill through a

unique regional public-private partnership between the Roanoke Valley Resource Authority and Norfolk-Southern Railroad. Emissions due to this transportation are not included in this analysis. They are expected to be less than would result from truck transport of the same waste due to rail transportation efficiencies.

The *Methane Commitment Method* was used in the CACP software to calculate greenhouse gas emissions due to landfill wastes. This method assigns all total lifetime greenhouse gas emissions from the waste disposed in the active year to that year. In reality, methane emissions occur over time from a landfill, but estimating this dynamic process accurately using a *Waste-in-Place Method* requires waste data, inception dates, and closing dates for all city landfills. This report will therefore use the *Methane Commitment Method* which assigns all of the methane emissions that will occur over the lifetime of the landfill in which the 2007 wastes were stored to the greenhouse gas inventory for 2007.

The available categories for waste and waste disposal methods in the CACP software are shown in Table 11. The default percentages are only for the “managed landfill” disposal method. Specific data for the breakdown of Roanoke County waste for the categories in the table were not available so default values corresponding to US averages provided by the CACP software help files were used and are also shown in the table.

Waste Categories	Default Percentages (%)
Paper Products	38
Food Waste	13
Plant Debris	10
Wood/Textiles	4
All Other Waste	35

Table 11: CACP Software Waste Disposal Options

Data from the Roanoke Valley Resource Authority (RVRA) is shown in Table 12. All of the waste which is not recycled was categorized for this analysis as handled by a Managed Landfill. None of the Roanoke County waste disposed in 2007 was composted or incinerated. Recycling is not considered as a source of emissions reduction by the CACP software in the baseline analysis, even though upstream emissions from manufacturing energy are reduced due to this practice. Emissions reductions due to recycling are considered, however, in the implemented measures analysis section in the software relating to ICLEI Milestones Three and Four.

Waste tonnage entered into the CACP software is the sum of the municipal and residential values for Roanoke County and Vinton. The waste from commercial and private haulers was not included since it is difficult to determine how to assign appropriate percentage to the correct jurisdiction.

Wood waste is handled by the RVRA, but does not go to the landfill. Therefore, it was not included in the emissions analysis.

SOURCE	TOTAL
MUNICIPAL COLLECTION	
COUNTY OF ROANOKE	38,920
TOWN OF VINTON	3,781
TOTAL MUNICIPAL	42,701
RESIDENTIAL DROP OFF	
COUNTY OF ROANOKE	3,726
TOWN OF VINTON	309
TOTAL RESIDENTIAL	4,035
	46,736
WOOD WASTE	
COUNTY OF ROANOKE	5,052
TOWN OF VINTON	130
TOTAL WOOD WASTE	14,452

Table 12: Tons of Roanoke County Solid Waste (2007)

Waste water treatment is not specifically addressed by the CACP software in terms of associated emissions. However, emissions due to electricity and natural gas used for waste water operations were included in the community analysis for facilities which are located within Roanoke County limits. Direct emissions of greenhouse gases and other pollutants are also associated with wastewater treatment; however, these were not assessed in this report since methodologies for this are neither well developed nor supported by the CACP software.

MUNICIPAL EMISSIONS INVENTORY

All municipal energy consumption records included in this report were provided by Roanoke County General Services staff—this includes electricity, natural gas, unleaded regular gas, and 2% biodiesel fuel. ICLEI has supplied Clean Air and Climate Protection (CACP) software wherein all municipal data has been entered. Once the energy data is entered, the software computes greenhouse gas emissions. The CACP software divides the municipal data into three sectors: buildings, vehicle fleet, and streetlights. The buildings sector comprises all County facilities including: administrative, public safety, fire and rescue stations, libraries, service centers and parks and recreation centers.

Vehicle fleet fuel usage includes all County cars, trucks, mowing and landscape maintenance equipment and fire department vehicles. Data was not collected for the Roanoke County school buildings and buses since that operation is separate from municipal government. Please note that school energy usage is included in the community carbon footprint. All data was collected for specific calendar years and the baseline year for this report is 2007. Complete energy records were available back to 2001, so this data was compiled for comparison purposes.

Buildings

Municipal building energy use data was provided by the Roanoke County Facilities Manager. In addition to those listed above, buildings analyzed included recreation centers, garages, public safety, and public services. Electricity, natural gas, and propane records were collected, as appropriate, for each building. In 2007, there were 519,777 square feet of building space for all Roanoke County municipal buildings. This figure represents an increase of 11.5 percent from 465,950 square feet in 2001.

Table 13 provides an energy use summary for each County building for the 2007 calendar year. Energy used in the County buildings includes electricity, natural gas, and propane. This table also details the sizes of each facility with its respective energy use in MBtu (1,000 btu) per square foot along with the associated costs on a per square foot basis.

Building	Square Footage (ft ²)	Energy Usage (MBtu)	Energy Cost (\$)	MBtu/ft ²	Cost/ft ²
RCAC	61,170	4,125,260	\$59,392	67.44	\$0.97
Courthouse	71,531	7,477,560	\$111,472	104.54	\$1.56
Court Services	18,000	891,616	\$16,176	49.53	\$0.90
PSC	85,198	9,104,768	\$136,308	106.87	\$1.60
Kessler Mill	70,676	3,201,033	\$43,775	45.29	\$0.62
Satellite Garage	2,000	290,956	\$4,219	145.48	\$2.11
Garage	5,500	442,025	\$6,520	80.37	\$1.19
Police Substation	960	85,119	\$1,556	88.67	\$1.62
Main Library	20,690	1,681,480	\$24,791	81.27	\$1.20
Glenvar Library	5,121	508,942	\$9,835	99.38	\$1.92
Hollins Library	17,671	1,624,313	\$25,871	91.92	\$1.46
Vinton Library	9,292	728,630	\$10,927	78.41	\$1.18
Cave Spring Fire	15,575	1,080,156	\$14,274	69.35	\$0.92
Catawba Fire	4,355	311,149	\$9,009	71.45	\$2.07
Hollins Fire	13,554	907,016	\$12,827	66.92	\$0.95
Mt. Pleasant Fire	9,348	784,456	\$11,034	83.92	\$1.18
Clearbrook Fire	10,725	990,832	\$14,007	92.39	\$1.31
Bent Mt. Fire	7,320	449,830	\$11,481	61.45	\$1.57
Ft. Lewis Fire	13,554	1,079,392	\$15,471	79.64	\$1.14
Mason Cove Fire	9,552	692,152	\$18,982	72.46	\$1.99
Back Creek Fire	9,400	774,971	\$10,835	82.44	\$1.15
Read Mt. Fire	11,124	964,638	\$13,950	86.72	\$1.25
Cave Spring Rescue	9,096	650,289	\$10,088	71.49	\$1.11
Brambleton Center	24,676	2,559,749	\$36,232	103.73	\$1.47
Catawba Center	4,737	27,590	\$579	5.82	\$0.12
Craig Rec	7,868	374,841	\$5,198	47.64	\$0.66
Walrond Park	1,084	234,130	\$3,909	215.99	\$3.61
Totals	519,777	42,042,893	\$638,718	80.89	\$1.23

Table 13: Roanoke County Buildings Square Footage and Energy Use (2007)

The four highest energy consumption buildings are the Administration Center (RCAC), Public Safety Center (PSC), Courthouse, and the Kessler Mill Public Service Center.

Column 5 in Table 13 Mbtu/ft², is very useful in that it indicates the relative energy efficiency with smaller numbers representing greater efficiency. Figure 11 below provides a detailed comparison of the four highest energy consuming buildings in 2007 with regard to area, energy cost, tons of CO₂ and energy consumption.

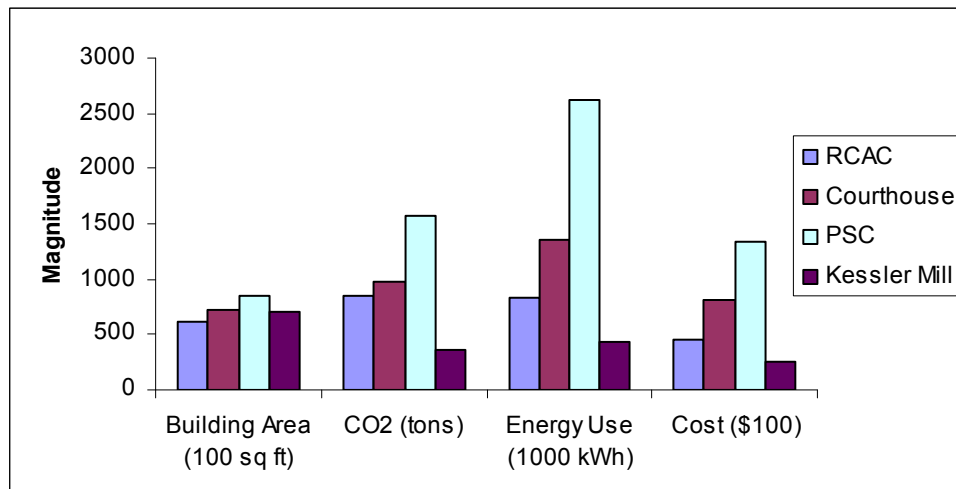


Figure 11: Comparison of the largest Roanoke County buildings (2007)

Table 14 shows the percent change in electricity use between the years 2001 and 2007 for the six different building categories. The apparent increase in electricity usage over the period is likely a result of the addition of two buildings (Public Safety and Garage Satellite) and subsequent increase in total square footage. These two buildings added a combined 87,198 square feet to the total area of municipal buildings in Roanoke County for 2007.

Building	2001 Electricity Use (kWh)	2007 Electricity Use (kWh)	% change
Administrative	2,101,249	2,323,940	10.60%
Public Safety	944,680	2,642,140	179.70%
Service Centers	628,384	482,964	-23.10%
Fire	1,115,142	1,209,866	8.50%
Libraries	1,115,545	972,800	-12.80%
Parks	376,445	539,484	43.30%
Totals	6,281,445	8,171,194	30.10%

Table 14: Electricity Use in Municipal Buildings (2001 vs. 2007)

Figure 12 shows 2001 vs. 2007 cumulative electricity usage measured in kilowatt hours for the six different municipal building categories.

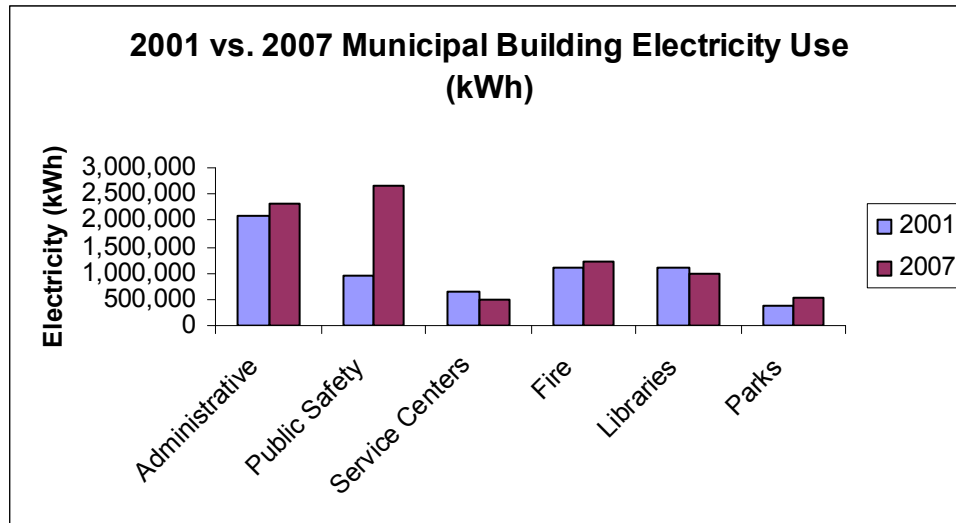


Figure 12: Energy Usage in Municipal Buildings (2001 vs. 2007)

In comparing the data in Figure 12 for building energy usage between the two periods, there was a considerable increase in electricity use for the Public Safety buildings of 1,697,460 kWh. This is attributable to an increase in total building area resulting from construction of a modern E911 dispatch center, including a data center and growth in the four departments that occupy the building. The fire & rescue stations and libraries decreased their electricity usage between the two years, while the County parks increased their electricity usage slightly.

Table 15 shows the percent change in costs associated with electricity usage between the years 2001 and 2007. This increase is due not only to the increase in total municipal building square footage, but also increasing electricity costs.

Building	2001 Electricity Cost (\$)	2007 Electricity Cost (\$)	% increase
Administrative	\$91,046	\$139,069	52.7%
Public Safety	\$40,005	\$135,346	238.3%
Service Centers	\$28,445	\$29,153	2.5%
Fire	\$55,294	\$73,781	33.4%
Libraries	\$41,048	\$57,402	39.8%
Parks	\$16,755	\$31,092	85.6%
Total	\$272,593	\$465,843	70.9%

Table 15: Electricity Cost in Municipal Buildings (2001 vs. 2007)

Table 16 shows the percent change in natural gas use between the years 2001 and 2007 for the six different building categories. It can be seen that overall natural gas use has decreased by 9.9 percent from the year 2001 to the year 2007. This can be attributed to energy conservation efforts undertaken at the larger County buildings from 2003 through 2006.

Building	2001 Natural Gas Use (kWh)	2007 Natural Gas Use (kWh)	% change
Administrative	1,442,436	1,336,930	-7.3%
Public Safety	221,574	50,097	-77.4%
Service Centers	798,476	669,702	-16.1%
Fire	1,275,062	1,122,147	-11.9%
Libraries	314,707	358,407	13.9%
Parks	315,521	397,034	25.8%
Total	4,367,776	3,934,317	-9.9%

Table 16: Natural Gas Usage in Municipal Buildings (2001 vs. 2007)

Table 17 shows the percent change in costs associated with natural gas usage between the years 2001 and 2007. Since the County's municipal buildings have decreased their overall natural gas use, this increase in overall cost is primarily due to the increase in the cost of natural gas.

Building	2001 Natural Gas Cpst (\$)	2007 Natural Gas Cost (\$)	% change
Administrative	\$39,429	\$47,971	21.7%
Public Safety	\$6,572	\$2,518	-61.7%
Service Centers	\$23,271	\$25,361	8.9%
Fire	\$39,115	\$44,359	13.4%
Libraries	\$10,095	\$14,022	38.9%
Parks	\$8,754	\$14,826	69.4%
Total	\$127,236	\$149,057	17.2%

Table 17: Natural Gas Cost in Municipal Buildings (2001 vs. 2007)

Figure 13 illustrates the relative percentages in tons of CO₂ emitted from each of the six building sectors. The Administrative and Public Safety buildings are the biggest contributors of CO₂. Administrative buildings account for 32%, the largest quantity of the CO₂ emissions for the municipal buildings category, with Public Safety coming in second with 26%.

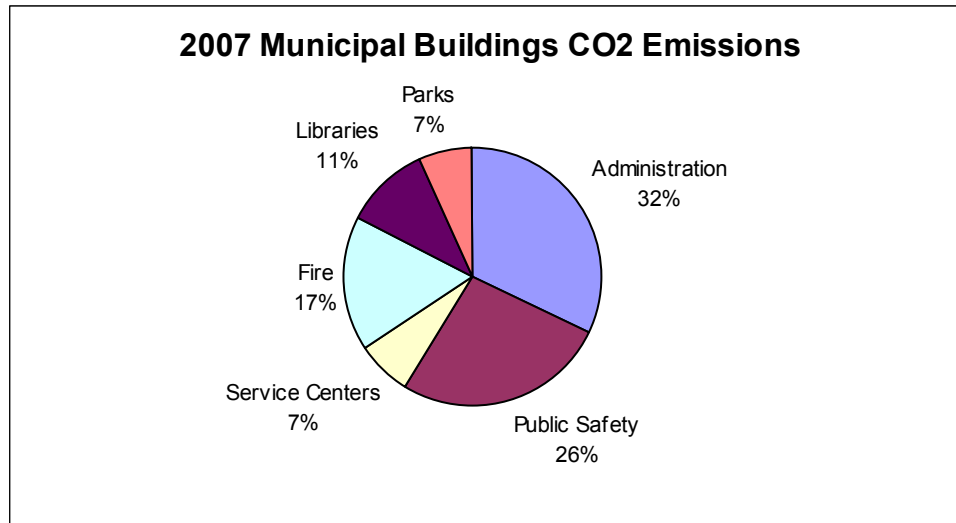


Figure 13: Roanoke County Percentage Municipal CO₂ Emissions by Sector (2007)

While the County buildings as a sector have experienced an increase of total CO₂ emissions between the years 2001 and 2007, Table 18 shows that the group with the largest increase in emissions was Public Safety. This, along with a 27% increase in Parks CO₂, contributed to the overall emissions increase of 11%. This is primarily due to a sizable increase in total building square footage from the addition of the new Public Safety Center.

Buildings	2001 CO ₂ Emissions (tons)	2007 CO ₂ Emissions (tons)	% change
Administration	1,958	1,939	-0.90%
Public Safety	680	1,582	132.60%
Service Centers	589	429	-27.20%
Fire	1,066	1,008	-5.40%
Libraries	814	654	-19.70%
Parks	319	405	27.00%
Total	5,426	6,017	11.00%

Table 18: Tons of CO₂ Emissions by building category (2001 vs. 2007)

Vehicle Fleet

Municipal fleet data was provided by the Roanoke County Garage staff and includes all County vehicles as well as Fire and Rescue department fuel. Table 19 shows the total gallons of diesel and unleaded gasoline used in the municipal fleet and the costs for the 2007 baseline year.

	Fuel Type	Gallons	Cost (\$)
2001	Diesel	117,465.30	95,793.88
	Unleaded	295,967.20	249,492.08
	Total	413,432.50	345,285.96
2007	Diesel	160,552.46	354,587.46
	Unleaded	381,497.06	844,427.59
	Total	542,049.52	1,199,015.05

Table 19: Roanoke County Fuel Use and Cost (2001 vs. 2007)

Figure 14 shows the combined total increase in gallons of fuel used by Roanoke County as well as the total cost change between the years 2001 and 2007.

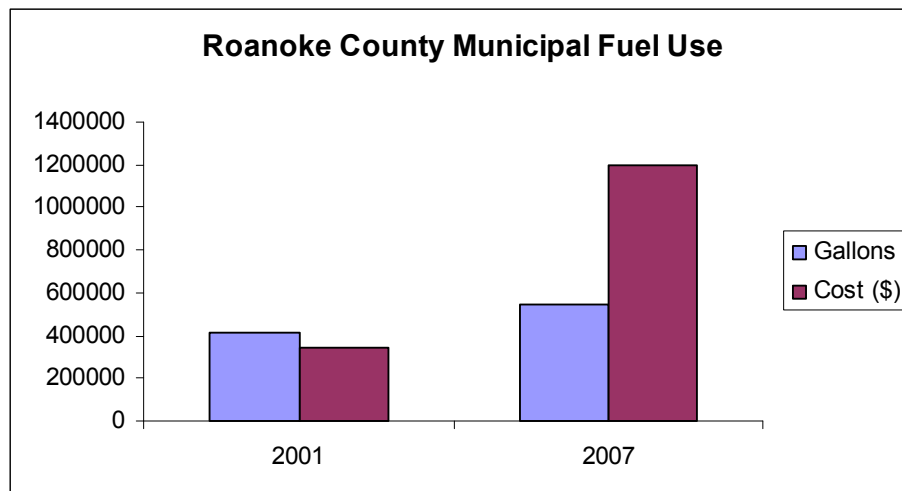


Figure 14: Roanoke County Municipal Fuel Use (2001 vs. 2007)

The most dramatic impact from fuel use for the County is in terms of cost. In 2001, the County used 413,432 gallons at \$345,285. In 2007, 542,049 gallons costing \$1,199,015 was used. The total gallons used in the Roanoke County fleet increased 31% between 2001 and 2007 while the cost increased 250%, thus causing havoc with department budgets.

Streetlights

All streetlight data was provided by the Community Development Department; however, the streetlights are owned by APCO. Roanoke County is billed monthly for usage. For the 2007 calendar year, there were a total of 1,437 streetlights costing \$119,620. This represents a 26% increase of \$24,941, up from 1,411 lights at \$94,679 in the 2001 calendar year.

Municipal Conclusions

The sector with the greatest contribution to Roanoke County's Carbon Footprint is the vehicle fleet accounting for 48% of the CO₂ emissions. County buildings contribute nearly as much with 46% of the CO₂ emissions. Streetlights within the County contribute just 6% or 833 tons of CO₂, a minor amount by comparison. Figure 15 shows the total percentages of CO₂ from all three energy consuming sectors.

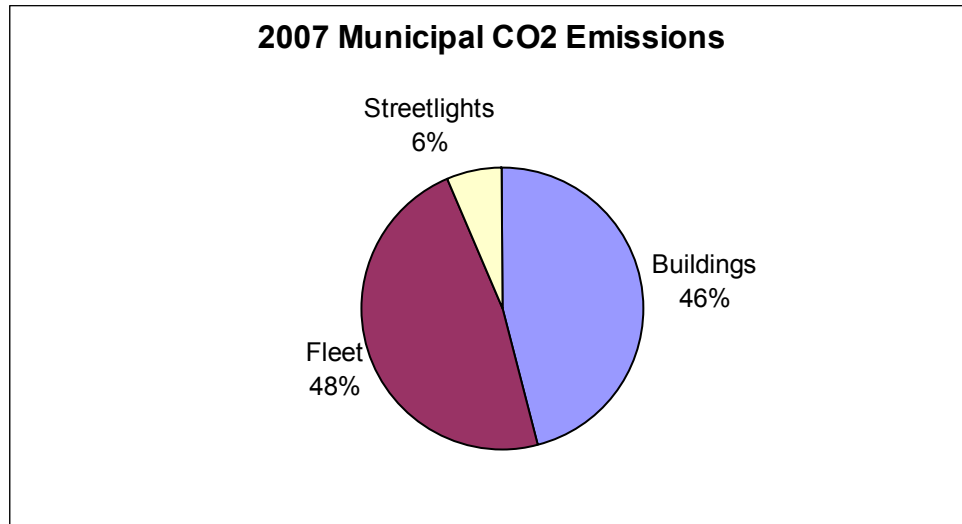


Figure 15: Percentage of Roanoke County Municipal CO₂ Emissions (2007)

Further analysis of CO₂ emissions by sector as listed in Table 20 indicates that Roanoke County's municipal buildings contribute 6,017 tons of CO₂, while the vehicle fleet adds a slightly higher quantity at 6,285 tons of CO₂. Roanoke County's municipal sector as a whole contributes 13,135 tons of CO₂. Given this relatively slim differential, mitigation efforts can be more or less concentrated equally between Fleet and Facilities.

Category	2001 Equivalent CO ₂ (tons)	2007 Equivalent CO ₂ (tons)	% increase
Buildings	5,427	6,017	10.9%
Fleet	3,598	6,285	74.7%
Streetlights	n/a	833	n/a
Total	9,025	13,135	45.5%

Table 20: Total tons of CO₂ for Roanoke County by Sector (2007)

Another way of viewing the County's CO₂ emissions is by the fuel "Source". As seen in Figure 16, electricity use, at 48%, is far and away the greatest contributor to the municipal carbon footprint. The use of gasoline is responsible for 32%, diesel 13% and natural gas 7%.

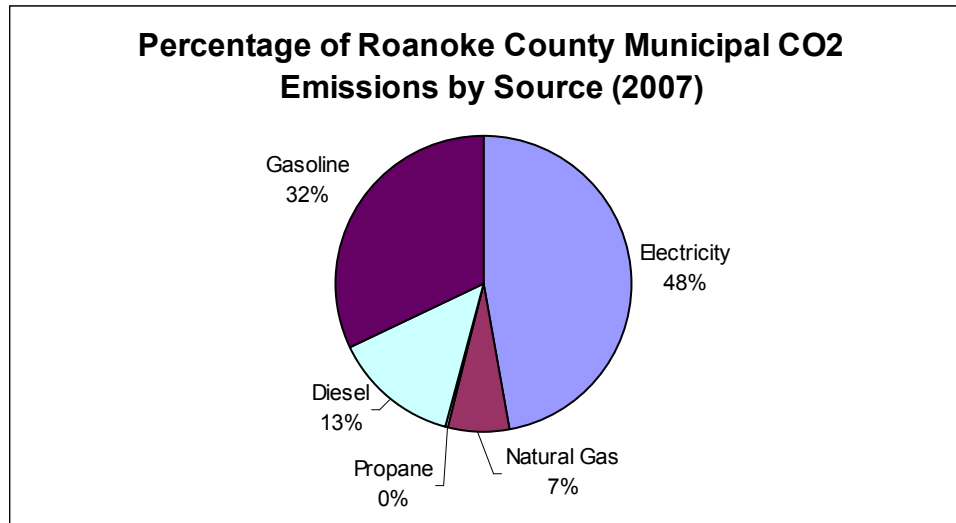


Figure 16: Percentage of Roanoke County Municipal CO₂ Emissions by Source (2007)

Category	2001 Equivalent CO ₂ (tons)	2007 Equivalent CO ₂ (tons)	% change
Electricity	4,455	5,967	33.9%
Natural Gas	920	830	-9.8%
Propane	51	53	3.9%
Diesel	419	2,115	404.7%
Gasoline	3,180	4,170	31.1%
Total	9,025	13,135	45.5%

Table 21: Total tons of CO₂ for Roanoke County by Source (2001 & 2007)

Table 21 lists actual tons of CO₂ emissions from each fuel source for the 2001 and 2007 calendar years along with totals and the percent change. The percent increase in the use of diesel is most dramatic and is attributable to the increase of services utilizing heavy trucks and equipment in the areas of solid waste collection, fire and rescue services and parks maintenance. Please note that the 2001 data does not include Fire and Rescue Department fuel due to lack of available data for that year.

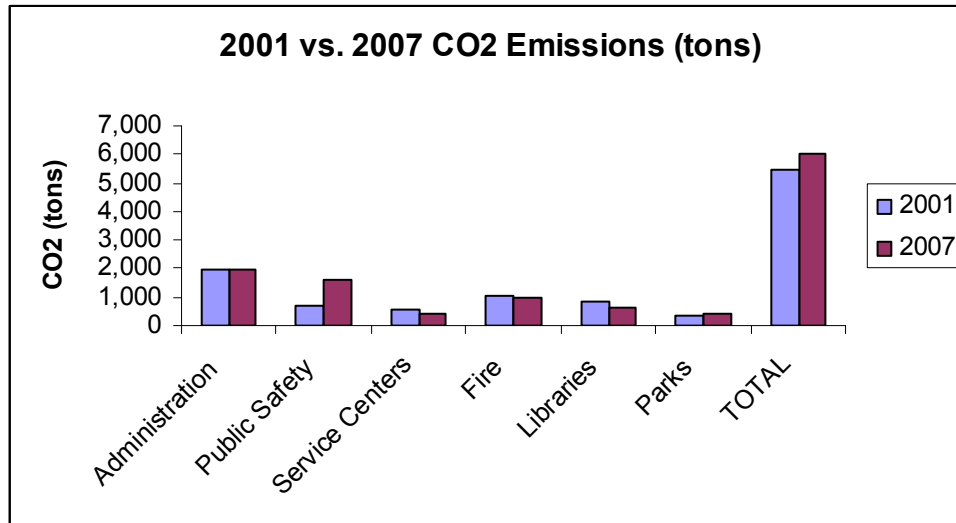


Figure 17: Municipal CO₂ Emissions (tons) by building sector (2001 vs. 2007)

While the overall municipal CO₂ emissions have increased, we can see in the figure above that there several building sectors that actually decreased due to energy conservation efforts, namely the libraries, service centers and fire stations. Since County buildings do have an impact on local GHG emissions and budgets (\$681,465 spent in 2007), it is vital to reduce building energy usage in the County operations. Not only would this lower carbon emission, but it would also save money. The County is also anticipating the addition of four major buildings within the next two years including the Fleet Service Center, Multi Generational Recreation Center, South County Library, and North County Fire Department. The addition of these four buildings will add roughly 184,600 square feet to the County's buildings causing another bump in energy costs.

The County's vehicle fleet contributed 6,285 tons of CO₂ (or about 48%) at a cost of \$1,199,015 on fuel in the 2007 baseline year. The cost of fuel was almost double what was spent on building energy. With the increasing costs of fuel, it is essential that the County continues to try and reduce fuel use. This could be achieved by either by purchasing more hybrid vehicles, reducing vehicle miles travelled, improving overall efficiency of the fleet, and developing policies to limit vehicular use.

As the County population continues to grow and the quantity and sophistication of services requested by the citizenry increase, controlling and reducing municipal carbon emissions will continue to present a challenge. However, reducing the County's carbon emissions will not only save money, but it will reduce our impact on the environment.

CONCLUSION

The bottom line in terms of CO₂ emissions is that the Roanoke County community as a whole was responsible for the emission of approximately 1.9 million tons of atmospheric CO₂ for the baseline year 2007. The charts below present the key findings in terms of

the CO₂ emissions inventory. In reviewing the results there are two major categories from which to analyze the data – sector and source.

The greatest amount, 730,971 tons or 39% of CO₂ by **sector**, is generated by residences through the use of electricity, natural gas and other fossil fuels used for heating and cooling. At 663,960 tons, the transportation sector is second with 36% of the total CO₂ generated. This is primarily in the form of gasoline and diesel and miniscule amounts of alternative fuels such as alcohol and biodiesel. Following in third place is the commercial sector with 309,360 tons CO₂ or about 17% of the total. Industrial represents the fourth greatest generator of CO₂ with 129,667 tons for 7% of the total. A very slight amount, 27,152 tons or about 1%, is attributable to waste.

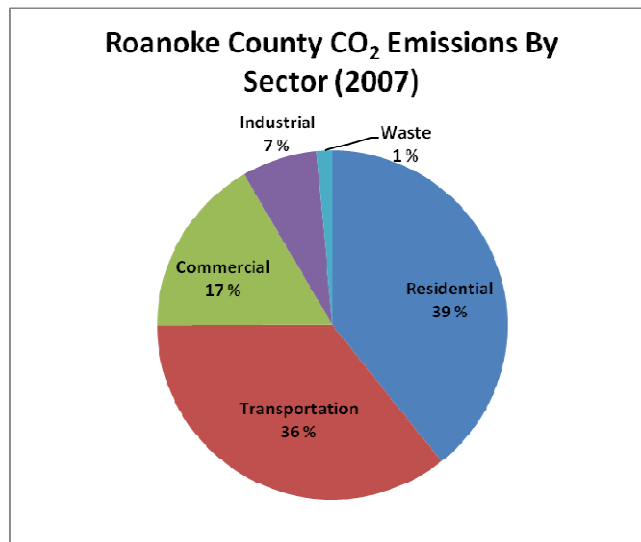


Figure 18: Roanoke County CO₂ Emissions by Sector (2007)

The second category wherein CO₂ emissions have been measured is by **source** which is the type of fuel utilized or combusted. Examination of Table 22 indicates that the use of electricity is responsible for nearly half of all CO₂ generated with 47% and 873,346 tons. It should be noted that this number is disproportionately large due to the high percentage of coal used in the generation of electricity for the region. At 25% and 473,054 tons, gasoline is the second greatest contributor with the bulk of the use in form of automobile fuel. Unfortunately, gasoline usage for non-motor vehicles could not be obtained due to inadequate record keeping and certainly there would be an increase, perhaps significant, via this source should that data be available.

Next in terms of total CO₂ by source is natural gas with 15% and 270,289 tons. The majority of natural gas consumed is utilized for heating residences and businesses; however, small quantities may be used for industrial processes and vehicle fuels. The fourth greatest quantity of CO₂ by source is diesel fuel at 10% and 190,906 tons which includes truck traffic on I-81 in Roanoke County. What it does not include is off road diesel which could be a sizeable volume. Unfortunately, data simply was not available. Light fuel oil contributes 2% of community CO₂ which, while a relatively small percentage, still represents the primary heating fuel for many homes and businesses. Propane

represents a mere 1% of the CO₂ generated despite the fact that many businesses and residents use this fuel for heating.

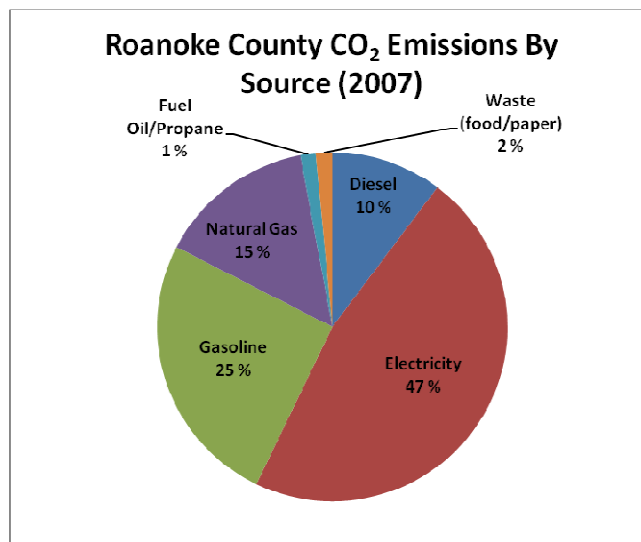


Figure 19: Roanoke County CO₂ Emissions by Source (2007)

Below are tables listing complete equivalent tons of CO₂ for all major **sectors** and all **sources** along with total energy consumption in millions of Btu's and relative percentages for each category. Please note that residential uses 2 million fewer MMBtus of energy but generates approximately 100,000 tons more of atmospheric CO₂. This is due to the high percentage of coal used in the generation of electricity for the region.

Community Sector	Equiv. CO ₂ (tons)	Equiv. CO ₂ (%)	Energy (Million Btu)	Energy (%)
Residential	730,971	39.3%	4,992,561	30.6%
Transportation	663,960	35.7%	7,738,413	47.4%
Commercial	309,360	16.6%	2,577,222	15.8%
Industrial	129,667	7.0%	1,029,391	6.3%
Waste	27,152	1.5%		
Total	1,861,110	100%	16,337,587	100%

Table 22: Community CO₂ Emissions by Sector (2007)

Community Source	Equiv. CO ₂ (tons)	Equiv. CO ₂ (%)	Energy (Million Btu)	Energy (%)
Electricity	873,346	46.90%	3901758	23.90%
Gasoline	473,054	25.40%	5537767	33.90%
Natural Gas	270,289	14.50%	4374869	26.80%
Diesel	190,906	10.30%	2200645	13.50%
Waste (food/paper)	28,358	1.50%		
Fuel Oil/Propane	26,363	1.40%	322546	2.00%
Waste (plants/wood)	-1,207	-0.10%		
Total	1,861,109	100%	16,337,585	100%

Table 23: Community CO₂ Emissions by Source (2007)

Another interesting perspective on GHG emissions can be gained by focusing on the energy used to produce them. Ultimately, in order to reduce GHG, specifically CO₂, energy must be conserved. Judging from Figure 20, the transportation sector is the greatest consumer of energy and in terms of btu's and gasoline (see Fig 15) is the most used fuel type. The irony remains, however, that electricity use in Roanoke County is still responsible for more CO₂ production and residences are responsible for more CO₂ than transportation due to the preponderance of coal fired electrical power plants supplying this area.

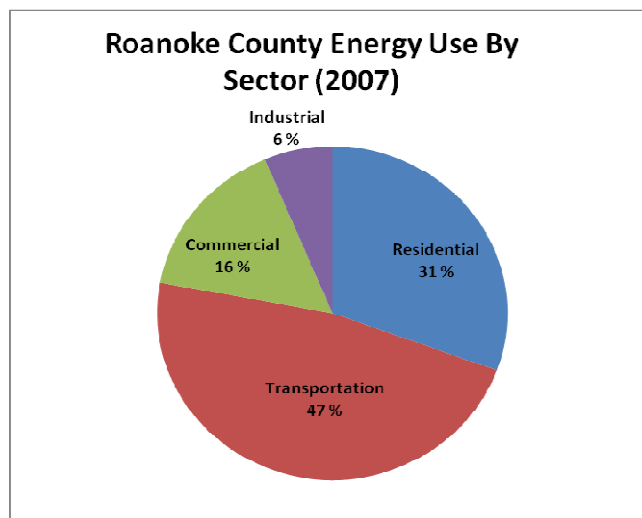


Figure 20: Percent Energy Use by Sector (2007)

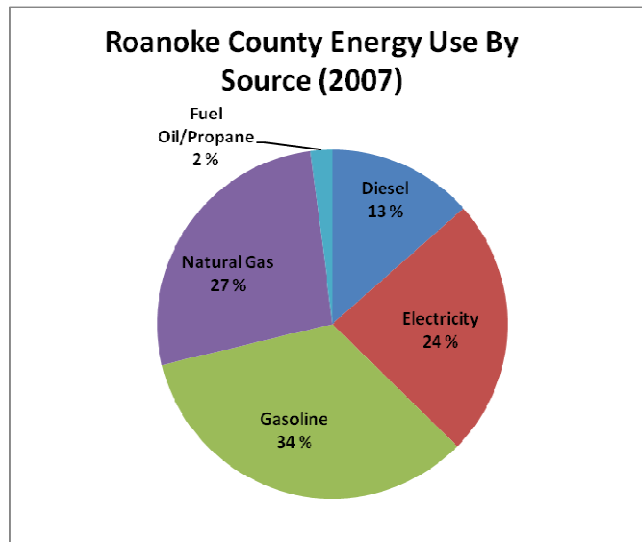


Figure 21: Percent Energy Use by Source (2007)

Lastly, it can be seen in Figure 2 on page 7 that the vast majority, 99.3% of all CO₂ in the County, is generated by the community at large while less than 1% is a result of government operations. Thus the efforts of a successful GHG reduction program must focus on all sectors of society including residences, transportation, commercial, industrial, religious and educational organizations. In addition, the major effort should focus on reduction of the use of coal generated electricity in the residential and commercial sectors followed by reduction in the use of gasoline and natural gas. The role of County Government can be that of an organizer and a facilitator, providing policy structure, technical assistance and the means for bringing all of the necessary stakeholders together.

References:

¹United States Environmental Protection Agency Website,
<http://www.epa.gov/methane/sources.html>

² Clean Air and Climate Protection Software – User’s Guide, June 2003

APPENDIX A

CO₂ from various fuel sources

Emissions are shown in units of CO₂ per Btu of energy in the fuel (not to be confused with carbon/Btu (the difference being the molecular weight of carbon, 12, vs. that of CO₂, 44, both of which units are used variously (and sometimes confusingly). Note that coal is 92 vs. natural gas at 53, gasoline at 70.5 and fuel oil at 72.5. The units are metric tons of CO₂ per billion Btu.

One also has to take into account the efficiency which can be achieved by a fuel during use. Conventional pulverized coal plants are fortunate to get close to 40% efficiency (usually less) due to energy used in post-combustion controls, while newer IGCCs can get higher efficiency. In comparison combined cycle (gas turbine plus steam cycle) existing natural gas plants get efficiencies in the 50 to 55% or greater range. That increases the GHG advantage of natural gas even further. New combined cycle NG plants emit less than half as much as a conventional coal plant per unit of electrical energy produced.

Fuel Type	Million Short Tons Carbon Dioxide per Quadrillion Btu	Million Metric Tons Carbon Dioxide per Quadrillion Btu ^(a)
Petroleum		
Motor Gasoline	77.7	70.5
LPG	69.1	62.7
Jet Fuel	77.9	70.7
Distillate Fuel	79.9	72.5
Residual Fuel	86.6	78.6
Asphalt and Road Oil ^(b)	84.2	76.4
Lubricants ^(b)	84.9	77.0
Petrochemical Feed	77.8	70.6
Aviation Gas ^(b)	77.7	70.5
Kerosene	77.9	70.7
Petroleum Coke ^(b)	109.2	99.1
Special Naphtha ^(b)	77.7	70.5
Other: Waxes and Miscellaneous ^(b)	84.2	76.4
Coal ^(c)		
Anthracite Coal	112.5	102.1
Bituminous Coal	101.5	92.1
Subbituminous Coal	105.0	95.3
Lignite	106.5	96.6
Natural Gas		
Flare Gas ^(b)	60.8	55.2
Natural Gas	58.2	52.8

(a) Assumes conversion of 1 quadrillion Btu = 1.0551 exajoules and fraction combusted = 99 percent.

(b) Emissions coefficients are EIA estimates based on underlying chemical composition of the product.

(c) Coal emissions factor is for 1990: varies by ± 0.2 percent in other years.

NA = not available.

Source: U.S. Department of Energy, Energy Information Administration. 1993. Table 11 in *Emissions of Greenhouse Gases in the United States 1985-1990*. DOE/EIA-0573. U.S. Government Printing Office, Washington, DC.

APPENDIX B

AT A REGULAR MEETING OF THE BOARD OF SUPERVISORS OF ROANOKE COUNTY, VIRGINIA, HELD AT THE ROANOKE COUNTY ADMINISTRATION CENTER ON TUESDAY, AUGUST 14, 2007

RESOLUTION 081407-3 REQUESTING APPROVAL TO JOIN LOCAL GOVERNMENTS FOR SUSTAINABILITY (ICLEI)

WHEREAS, the U.S. Conference of Mayors endorsed the 2005 U.S. Mayors' Climate Protection Agreement initiated by Seattle Mayor Nickels and signed by 592 mayors in the United States as of June 2007; and

WHEREAS, the Urban Environmental Accords adopted by local government delegates during UN World Environment Day 2005 call for reduced emissions through energy efficiency, land use and transportation planning, waste reduction, and wiser energy management; and

WHEREAS, 162 countries including the United States pledged under the United Nations Framework Convention on Climate Change to reduce their greenhouse gas emissions; and

WHEREAS, energy consumption, specifically the burning of fossil fuels, accounts for more than 80 percent of U.S. greenhouse gas emissions; and

WHEREAS, the use of energy and fuel have an impact on the citizens of Roanoke County, Virginia, through air quality, government operational cost, and resident quality of life, and;

WHEREAS, local government actions taken to reduce greenhouse gas emissions and increase energy efficiency provide multiple local benefits by decreasing air pollution, creating jobs, reducing energy expenditures, and saving money for the local government, its businesses, and its residents; and

WHEREAS, the Cities for Climate Protection® Campaign sponsored by ICLEI – Local Governments for Sustainability has invited the County of Roanoke, Virginia, to join ICLEI and become a partner in the Cities for Climate Protection Campaign.

NOW THEREFORE, BE IT RESOLVED, that the County of Roanoke, Virginia, will join ICLEI as a full member and participate in the Cities for Climate Protection Campaign and, as a participant, pledges to take a leadership role in promoting public awareness about the causes and impacts of climate change; and

BE IT FURTHER RESOLVED, that the County of Roanoke will undertake the Cities for Climate Protection Campaign's five milestones to reduce both greenhouse gas and air pollution emissions throughout the community, and specifically:

- Conduct a greenhouse gas emissions inventory and forecast to determine the source and quantity of greenhouse gas emissions in the jurisdiction;
- Establish a greenhouse gas emissions reduction target;
- Develop an action plan with both existing and future actions which when implemented will meet the local greenhouse gas reduction target;
- Implement the action plan;
- Monitor and report progress; and

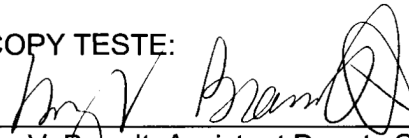
BE IT FINALLY RESOLVED that the County of Roanoke, Virginia, requests assistance from ICLEI's Cities for Climate Protection Campaign as it progresses through the milestones.

On motion of Supervisor Wray to adopt the resolution and appoint a Board liaison
at a later date, and carried by the following recorded vote:

AYES: Supervisors Wray, Church, Altizer, Flora, McNamara

NAYS: None

A COPY TESTE:



Mary V. Brandt, Assistant Deputy Clerk
Roanoke County Board of Supervisors

Cc: Anne Marie Green, Director, General Services

APPENDIX C



STATEMENT OF UNDERSTANDING

In recognition of the mutual benefits and consideration described below, Roanoke Valley Cool Cities Coalition (RVCCC) and the government of Roanoke County (the County) agree as follows:

RVCCC shall contract with two independent consultants, Sean McGinnis and Renee Godard (the Consultants), to provide assistance to the County in measuring and reducing the greenhouse gas emissions in the Roanoke County community and Roanoke County government. Work shall be accomplished through an ICLEI Planning Group (IPG) consisting of Charlotte Moore, Jim Vodnik, Anne Marie Green, Lindsey Hudson (student intern), Sean McGinnis, Renee Godard, and Diana Christopulos (RVCCC Board Chair).

Work shall begin on or about May 27, 2008 and conclude on or about August 25, 2008.

All data and reports collected and generated in the process shall be the property of the County.

The County is a member of ICLEI Local Governments for Sustainability. The Consultants will assist the County in achieving the following ICLEI Milestones:

1. ***Measure emissions.*** Establish a baseline measurement of greenhouse gas emissions by both the local government and the entire community. Work on this milestone shall begin on or about May 27, 2008 and conclude on or about August 25, 2008. It shall include the following elements:
 - a. Scoping: what will and will not be measured; format of data; what formulas will be used for local emissions (especially electricity sources, since the Roanoke Valley has an unusually high reliance on coal-fired power plants).
 - b. Collecting and entering data into ICLEI's Clean Air and Climate Protection software.
 - c. Analyzing data to reach conclusions about emissions sources and potential cost-effective reduction strategies for both government operations and the entire local community.
 - d. Writing a report that summarizes baseline emissions findings and potential cost-effective reduction strategies.
2. ***Recommend long-term and short-term targets for emissions reductions.*** The project report shall include recommended long-term and short-term targets for emissions reduction. Work on this milestone conclude on or about August 25, 2008.
3. ***Make a plan (with strong community involvement).*** Time permitting, the consultants will assist the County in organizing and forming a Citizens Climate Action Committee (CCAC) that will begin work on a plan to reduce greenhouse gas emissions throughout the community. In addition, RVCCC volunteers will assist in all aspects of the CCAC's work. Work on this long-term milestone shall be ongoing. Tasks shall include:
 - a. Identify and recruit leaders from all key community sectors (retail, construction, manufacturing, nonprofits, education, etc.) to form a Citizens Climate Action Committee.

- b. Share information about current emissions and potential reduction strategies among government and community representatives.
- c. Develop Local Action Plans for both local government and the larger community.
- RVCCC shall provide payment to the Consultants based on the following timetable:
 - Upon acceptance of their contracts by RVCCC (no County verification required)
 - Upon completion of data collection and entry for both the County government and the larger community, as certified by the County via email or written confirmation.
 - Upon completion of a final report to the County that summarizes baseline emissions findings and potential cost-effective reduction strategies and recommends long-term and short-term targets for emissions reduction, as certified by the County via email or written confirmation.

Role of Roanoke County

The County will:

- Recruit, hire and compensate a summer intern:
- Verify to RVCCC, by email or in writing, that the Consultants have completed their part in
 - Data collection and entry for both the County government and the larger community, as certified by the County via email or written confirmation.
 - Final report to the County that summarizes baseline emissions findings and potential cost-effective reduction strategies and recommends long-term and short-term targets for emissions reduction, as certified by the County via email or written confirmation.
- Acquire software from ICLEI and use ICLEI as a resource
- Own the data involved in measuring and reducing the local carbon footprint, and determine the amount and form of data distribution
- Publicize information about the community and government carbon footprints, including information to help local businesses, nonprofits and households reduce their emissions
- Identify related projects that might benefit from external funding
- Participate in meetings of the ICLEI Planning Group (IPG)
- Work closely with consultants, especially in scoping of baseline emissions measurement, preparing report and recommendations, and setting reduction target
- Work with consultants to train and orient intern
- Take primary responsibility for collection of data on local government greenhouse gas emissions
- Collect or assist in collection of community-wide data
- Provide workspace and a computer for use by Intern
- Provide access to people and records required for project completion
- Present Board of Supervisors with report on baseline emissions and recommended targets for reduction
- Identify, recruit and convene a Citizens Climate Action Committee (Roanoke County)
 - Roanoke County contact: Jim Vodnik, Assistant Director, General Services, (540) 387-6115 jvodnik@RoanokeCountyVA.gov
 - Other IPG members: Anne Marie Green, Director, General Services, agreen@roanokecountyva.gov 540-204-0218; Charlotte Moore, Roanoke County Board of Supervisors Roanokemoore@aol.com 540-556-1951

Role of RVCCC

RVCCC is a private, tax-exempt 501.c.3 organization registered in Virginia. RVCCC volunteers Diana Christopulos and Mark McClain will:

- Manage and disburse funds to consultants. RVCCC shall provide payment to the Consultants based on the following timetable:
 - Upon acceptance of their contracts by RVCCC (no County verification required)
 - Upon completion of data collection and entry for both the County government and the larger community, as certified by the County via email or written confirmation.
 - Upon completion of a final report to the County that summarizes baseline emissions findings and potential cost-effective reduction strategies and recommends long-term and short-term targets for emissions reduction, as certified by the County via email or written confirmation.
- Establish a contract with each consultant as an independent contractor
- Assist in identification, recruitment and work of Citizens Climate Action Committee
- Deliver presentations to educate local governments and citizens on measurement and reductions
- Help publicize and promote emission reduction efforts through the RVCCC website and other media
- Participate in meetings of the ICLEI Planning Group (IPG)
 - Diana Christopulos, Coordinator and Board Chair, dianak16@earthlink.net, 387-0930
 - Mark McClain, Treasurer and Board Member, mcclainmark@comcast.net, 387-0930

Role of Consultants

Consultants have been identified based on:

- Their experience in using software to measure greenhouse gas emissions (carbon footprint)
- Their knowledge of strategies to reduce greenhouse gas emissions
- Their community leadership in addressing global warming

The role of Consultants will be:

- Working with County staff and elected officials, provide expert leadership in scoping measurement projects, identifying data to be collected and the format in which it should be delivered, overseeing intern data entry and analysis, and assist with preparing and finalizing reports and recommendations to local governments, including recommended emission targets
- If necessary, assist in collection and analysis of data for entire community.
- In working with local community groups and businesses, provide education and expertise on how to measure and reduce greenhouse gas emissions
- Work with County staff to assure that student Interns receive appropriate orientation and training
- Participate in meetings of the ICLEI Planning Group (IPG)
 - Sean McGinnis, smcginnis67@yahoo.com, c 540-589-3580
 - Renee Godard, rgodard@hollins.edu, , 540-362-6457

Role of student intern

Intern's responsibility will include the following (see the County's intern job description for details):

- Learn how to use software (training provided by ICLEI, county staff and/or consultants)
- Care for computer belonging to the County – where data will be housed
- Prepare reports as determined by ICLEI Planning Group (IPG)
- Assist in collecting data on emissions by local government and community
- Enter emissions data provided for local government and community

- Analyze data on emissions of local government and community
- Identify and test potential emissions reduction strategies using ICLEI software
- Participate in writing a report for local government (carbon footprint and potential reduction strategies)
- Keep a record of how much time it takes to enter the data
- Participate in meetings of the ICLEI Planning Group (IPG)
 - Lindsey Hudson, lehudson@roanokecountyva.gov

 Diana Christopulos
 Board Chair, Roanoke Valley Cool Cities Coalition

Date _____

 Signature

Date _____

 Name and title, Roanoke County

APPENDIX D

